United States Department of Agriculture

# Pueblo Ridge Restoration

## Environmental Assessment

Forest Service Carson National Forest Camino Real Ranger District

Updated November 2020

**For More Information Contact**

Sean Ferrell
Camino Real Ranger District
Carson National Forest
15160 State Road 75
Peñasco, NM 87553
sean.ferrell@usda.gov
575-587-2255

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

We make every effort to create documents that are accessible to individuals of all abilities; however, limitations with our word-processing programs may prevent some parts of this document from being readable by computer-assisted reading devices. If you need assistance with any part of this document, please contact the Carson National Forest at 575-587-2255.

# Contents

## List of Tables

## List of Figures

# 1. Introduction

This environmental assessment determines whether effects of the proposed activities may be significant enough to prepare an environmental impact statement. By preparing this environmental assessment, we are fulfilling Agency policy and direction to comply with the National Environmental Policy Act and other relevant Federal and State laws and regulations.

## 1.1 Format of this Environmental Assessment

The Council on Environmental Quality regulations define an environmental assessment as:

> "A concise public document that serves to "briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact (FONSI)."

This document is consistent with the direction set forth in the Code of Federal Regulations regarding the requirements for an Environmental Assessment (40 CFR 1502.14(c)). This environmental assessment does not include sections that are not required but have historically been included: National Environmental Policy Act process language, irreversible and irretrievable commitment section, extensive list of existing conditions or standards and guidelines from the forest plan, a list of preparers, and a no-action alternative

A no-action alternative was not included because existing baseline conditions as described below convey the extent to which the project area is departed from desired conditions, which are based on best available science and historical ranges for measures of forest integrity such as stand density, species composition, forest structure, and fire hazard. Therefore, it was determined the purpose and need of the project is adequately supported without the analysis of a no-action alternative. Additional documentation, including more detailed analyses of project area resources, may be found in the project planning record, which is available upon request.

## 1.2 Project Location and Background

The Pueblo Ridge Restoration Project encompasses 9,724 acres (including 15 acres of private inholdings) and is located on the Camino Real Ranger District within an area susceptible to insect and disease threats that could impact forest health and increase the undesired effects of high-severity wildland fire (see figure 1). This is a product of overstocked conditions that jeopardize key ecosystem functions. The project would improve resilience by reducing the density of small trees and ladder fuels that cause fires to travel from the ground and into the larger trees. This project would also improve forest health by reducing the numbers of trees competing for nutrients and sunlight and would increase the diversity of the sizes and types of trees within the project area.

Carson National Forest personnel and residents of communities in Taos Canyon are concerned about wildfire risk to private residences and infrastructure adjacent to National Forest System lands, especially in light of the wildfires that have affected communities of the Southwest in recent years. There is a particular concern with the area east of the Town of Taos in the wildland-urban interface along the heavily trafficked Highway 64 corridor in Taos Canyon. Existing and potential hazardous fuel accumulations near and adjacent to residences in Taos Canyon and the Taos Pueblo create safety concerns for firefighters, residents, and visitors and the potential degradation of natural resources.

The project is being designed to create a landscapethat improves the resilience of vegetation in response to wildland fire and insect and disease outbreak and encourages the return of low- and moderate-intensity fire as a natural process in the ecosystem.

This project is located in portions of Sections 13 through 16 and 23 through 25, Township 25 North, Range 13 East; Sections 7 through 11 and 13 through 32, Township 25 North, Range 14 East; and Sections 7, 18, 19, and 30, Township 25 North, Range 15 East, Taos County, New Mexico Principal Meridian.

## 1.3 Purpose and Need for Action

The purpose of the Pueblo Ridge Restoration Project is to improve the health and sustainability of forested conditions in, and surrounding, the project area by reducing hazardous fuels and moving vegetation conditions in the project area toward the desired conditions.

The needs for the Pueblo Ridge Restoration Project include:

- improving tree vigor and stand resilience to reduce the risk of tree mortality from insects and disease
- reducing overall stand densities and moving stand conditions toward forest structures considered to be more typical of forest structure under presettlement fire regimes that have exhibited resilience to disturbance
- reducing the risk for high-intensity, stand-replacing wildfires
- reintroducing fire as a natural part of the ecosystem
- reducing fuel build-up to help prevent the spread of wildfire onto private property and into drainages leading into Taos Cannyon and Taos Pueblo lands
- providing forest products, such as fuelwood, for people living in Taos and the surrounding area, while protecting these resources for future generations
- improving habitat for wildlife and forage for range and wildlife
- protecting project area watersheds and associated water quality

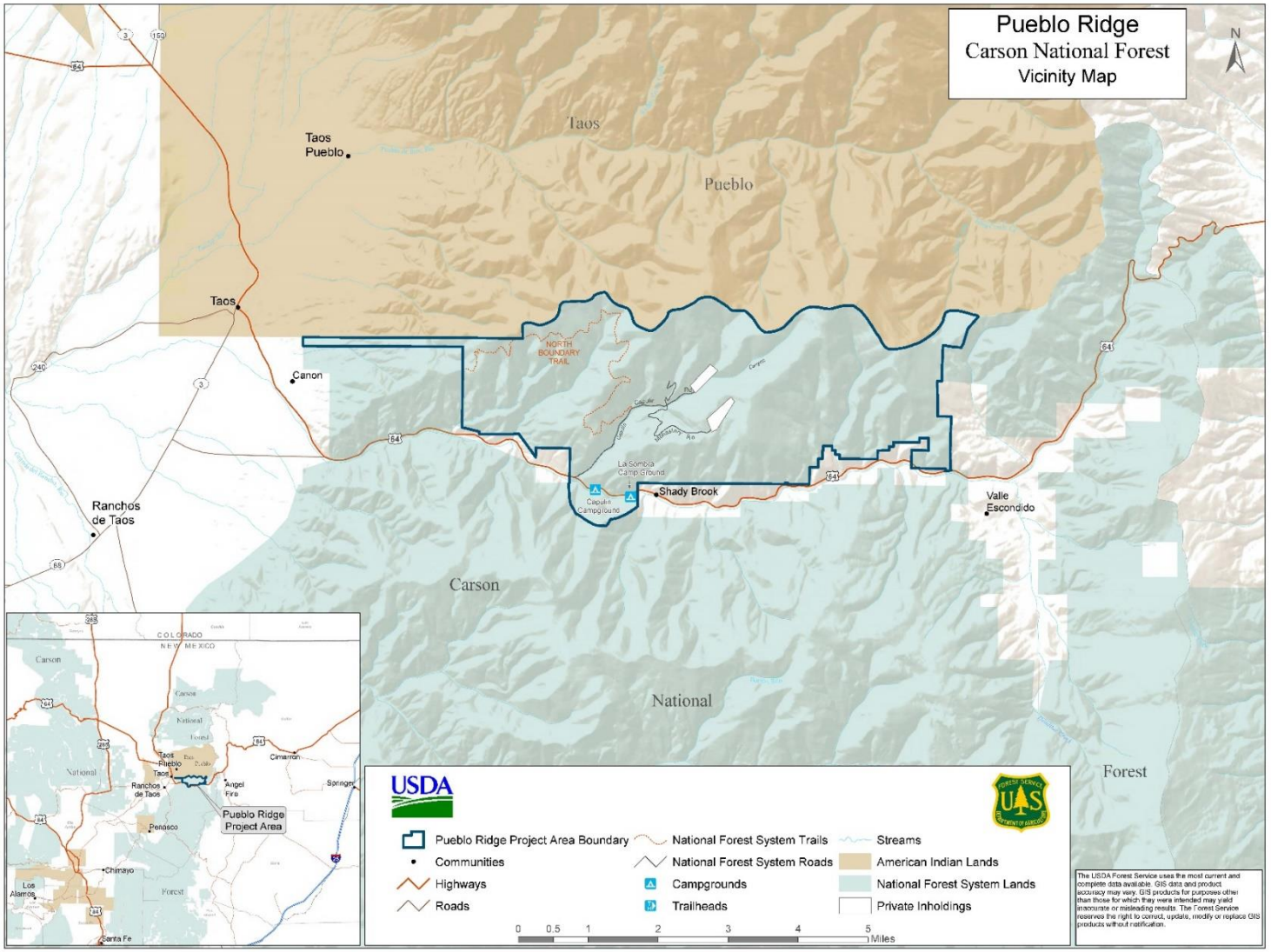


**Figure 1. Pueblo Ridge Restoration project area**

## 1.3.1 Existing and Desired Conditions

The purpose and need for the project is based on the difference between the existing and the desired conditions in the project area as described in the next section for applicable resources. Desired conditions are based on a combination of the management direction in the forest plan, best available science, and the historic range of variability. Current existing conditions do not resemble the historic range of variability. Most current forest structures are even-aged and lack structural diversity. Continuous fuel conditions on the landscape are conducive to stand-replacing wildfire. Low-severity fires do not occur on the landscape at their natural rate of return. Native insects and disease occur at higher than normal rates.

### 1.3.1.1 Existing Conditions

#### *Vegetation*

Current forest vegetation conditions are the result of various human activities that have resulted in departure from the historic range of variability of the forests and shaped the existing forest structure and composition. Due to these changed conditions, forests have experienced lowered resistance and resilience to disturbance agents.

Existing stand densities are considerably higher than the historic range of variability when measured by relative density. These elevated stand densities, when combined with drought, can make the existing stands very susceptible to disturbance agents, including bark beetles, spruce budworm, and root diseases.

There has also been considerable deviation from the historical stand structure. Stand structure is increasingly homogenous, and openings once dominated by grasses and forbs have been encroached and overtopped with conifers. Stands that were more open and dominated by large-diameter trees now exhibit interlocking crowns with small-diameter, shade-tolerant tree species creating fuel ladders from the forest floor into the canopies of the dominant trees.

Many of the stands in the project area are undergoing species conversion from shade-intolerant species to shade-tolerant species. The shade-intolerant tree species tend to be the older and larger dominant trees in most stands. These large trees are being outcompeted by younger shade-tolerant tree species, and the shade-intolerant larger trees are not able to reproduce. Stands of aspen are being encroached upon and overtopped by conifers, and they are slowly retreating on the landscape (Guyon 2006; Smith and Smith 2005). In many areas, riparian vegetation is also being encroached upon and overtopped by conifers.

Current conditions in the project area include predominately moderate to large trees with moderate to high stand and canopy densities. Openings and areas that provide space for grasses, forbs, and young shrub vegetation are underrepresented on the landscape. Meadows and aspen stands have been encroached by conifers, and there is reduced forage and small openings for wildlife and permitted livestock. Coniferous tree species have encroached within some riparian areas, overtaking deciduous riparian species such as cottonwood, willow, and alder.

### Fire and Fuels

Fire has played an important ecological role in the history of the ecosystems of the Carson National Forest. The spread of natural fire across the landscape has decreased dramatically and has corresponded with an increased demand for wildland fire suppression to protect life and property. The reduction in spread of fire across the landscape is, in part, a result of more than a century of intensive human activities, including fire suppression, livestock grazing, and logging. These changes have caused increased tree densities and reduced structural and spatial heterogeneity of vegetation.

In 2016, a tree-ring fire history study was conducted by New Mexico Landscapes Field Station personnel (U.S. Geological Survey and National Park Service) in the Taos Valley watersheds, including the Rio Fernando watershed. Trees in the area surrounding the Pueblo Ridge Restoration project area were sampled. The study noted fire commonly burned synchronously between the Rio Pueblo de Taos and the Rio Fernando watersheds. Thirty-six trees sampled in the Pueblo Ridge area had forty-five recorded fires with minimum fire return intervals ranging from 2 to 8 years (Johnson and Margolis 2017).

Vernon Bailey provided a narrative overview of the Taos Mountains in September 1903 describing the proposed Taos Forest Reserve that later became the Carson National Forest (Johnson and Margolis 2017). Bailey's description of repeated burns and old ponderosa and Douglas fir trees in the lower-elevation conifer forests suggests the presence of low-severity and likely also mixed-severity fire regimes in lower elevations of the Rio Pueblo and Rio Fernando drainages. The township that includes the Pueblo Ridge Restoration Project area was reported to be ravaged by numerous and periodical fire (Johnson and Margolis 2017).

Since 1971, twenty-two fires have occurred within the Pueblo Ridge Restoration project area. Approximately 195 acres (2 percent) of the project area have burned.

### Watershed

Watershed resources in the project area are primarily located in two mainly forested subwatersheds: Headwaters Rio Fernando de Taos and Outlet Rio Fernando de Taos. These subwatersheds contain several perennial streams, including the Rio Fernando de Taos, and a network of intermittent and ephemeral channels with associated riparian areas. Perennial springs also occur in the project area.

Soils in the watersheds vary with regards to erosion risk. The road network predominantly poses the highest risk for increased sedimentation into the project watersheds, especially where roads cross stream channels. Several roads have been rehabilitated in the watersheds. One stream—the Rio Fernando de Taos on the southern border of the project area—is experiencing water quality impacts; it is listed for *Escherichia coli (E. coli)* bacteria. Overall, existing conditions have been classified as functioning at risk because the watershed condition in the project area is poor for fire regime condition, road and trail condition, and the condition of aquatic biota and fair for the water quality, riparian and aquatic habitat, and soils.

#### 1.3.1.2 Desired Conditions

The overall goal of this restoration project is to improve the health and sustainability of forested conditions in and surrounding the project area. The primary objective for forest health is to increase resilience of forested stands. Increased resilience of these stands can be achieved through reduction of existing stand densities, reduction in the amount of shade-tolerant species,[1] and removal of overtopping and encroaching conifers from aspen and riparian areas.

The alternatives would strategically break up the continuity and arrangement of existing and future hazardous fuels within the wildland-urban interface in Taos Canyon (an at-risk community), while maintaining ecosystem structure and processes. Treatments would be designed to mitigate existing and future heavy fuel accumulations; reduce existing surface and ladder fuels; and create canopy breaks, crown separation, or both to minimize crown fire potential in the event of a wildfire. Desired conditions from the forest plan specific to this project for fire, sustainable forests, timber, wildlife, and recreation are listed in appendix E.

# 1.4 Public Involvement

## 1.4.1 Collaboration and Scoping

This project has been an integral component of a larger landscape-scale community-based collaborative initiative referred to as the Taos Valley Watershed Coalition. This initiative has brought together representatives of the Carson National Forest, the Nature Conservancy, New Mexico Department of Game and Fish, New Mexico State Forestry, Taos County, Taos Pueblo, Taos Ski Valley, the Village of Taos Ski Valley, the Town of Taos, Trout Unlimited, Taos Soil and Water Conservation District, New Mexico Wildlife Federation, El Salto de Agua Land Association, and a number of Firewise community groups to discuss cohesive cross-boundary priority projects around the Taos area. This project is an integral part of Taos Valley Watershed Coalition's landscape restoration strategy,[2] which was finalized in July 2015. As part of that strategy, a larger cross-boundary Pueblo Ridge effort was determined to be a priority landscape project.

This project is also informed by the 2016 update of the Taos County Community Wildfire Protection Plan. The core team working on this plan has met regularly with Carson National Forest personnel and has collaborated on the design of this project. This project is also informed by a collaboration with U.S. Geological Survey and the New Mexico Landscapes Field Station personnel; they have conducted a tree-ring fire history study of select watersheds in the vicinity of Taos, including the watershed being analyzed for treatment in this project. The management recommendations from the study have been adopted into the design of this project.

This project was listed in the Carson National Forest quarterly schedule of proposed actions beginning in October 2017 and has been listed on every quarterly schedule of proposed actions since then.

[1] Shade-tolerant species can survive in the shade of other trees. These species include white fir, Engelmann spruce, subalpine fir, and to some extent Douglas fir.

[2] https://allaboutwatersheds.org//library/inbox/tvwc-landscape-restoration-strategy/view

Forest Service personnel hosted an open house on March 1, 2018; it was attended by 17 people from local communities. Written comment forms were submitted by five attendees; the comments focused on thinning techniques to improve wildlife habitat, erosion control, range forage, and stream restoration. Attendees also emphasized their personal values in the project area, including water, grazing, timber, clean air, fuelwood, game, and personal experiences of peace and quiet. Overall, written and verbal feedback from the open house was supportive of the project and highlighted the need for treatments in the project area.

Based on feedback from the open house and desired conditions, the preliminary environmental assessment analyzed two alternatives for this project: the proposed action that included the forest plan amendments (alternative 1) and an alternative without the forest plan amendments (alternative 2). Alternative 2 differentiated the consequences of hazardous fuels and stand conditions on key resources from the effects of alternative 1. The preliminary environmental assessment displayed the effects of the alternatives by contrasting the impacts of the alternatives with the current condition and expected future condition.

In accordance with the Forest Service's project-level predecisional administrative review process (36 CFR 218.24), a 30-day public comment period was designated between May 16th, 2019 and June 17th, for the preliminary environmental assessment prepared for the Pueblo Ridge Restoration Project, as described in a legal notice published in the Taos News on May 16th, 2019. Copies of the legal notice and the preliminary environmental assessment were published to the Carson National Forests website on May 16th, 2019. Also, an availability letter was mailed to 44 individuals, organizations and agencies, and an availability email was sent to 109 individuals, organizations and agencies identified as either interested, affected, or both. The legal notice, letter, and email included a description of the modified proposed action, information on how to access the full preliminary environmental assessment, and instructions on how to comment on the preliminary environmental assessment.

During the comment period, Carson personnel hosted an open house on May 29th, 2019 to answer questions from the public about the project and to gather comments attendees had about the project. Seventeen individuals registered as attendees at the open house, with many more participating but not registering as attendees.

A total of eighteen written comment letters or emails were received during the comment period. As a result of these comments, proposals in the environmental assessment, including project design features, were updated to address confusion, and language was added to the environmental impacts section to better clarify effects of the alternatives. A list of these clarifications and modifications, as well as detailed responses to comments received during the 30-day public comment period, can be found on the project website at https://www.fs.usda.gov/project/?project=52575.

## 1.5 Issues and Alternative Development

An issue is an effect caused by some element of the proposed action or an alternative around which there is disagreement or concern. Issues may be addressed through different alternatives, design features, or mitigation measures. An interdisciplinary team and the recommending official reviewed feedback from the March 2018 open house for potential issues related to the project. The responsible official was briefed and concurred with the findings.

After considering comments from the open house, the following seven issues were identified and are addressed in the analysis through design features or mitigation measures:

- resilient forests
- reducing hazardous fuels
- watershed protection
- stream restoration
- fuelwood availability and accessibility
- cultural resource site protection
- improving wildlife habitat

## 1.5.1 Alternatives

Two alternatives are proposed for this project: Alternative 1 – Proposed action, forest plan amendments and Alternative 2 – No forest plan amendments. The alternatives are further described below, separated by activity.

### 1.5.1.1 Forest Plan Amendments

#### *Alternative 1*

The Carson forest plan, currently under revision, was written in 1986 and no longer incorporates best available scientific information. Anticipating the potential for this, both the National Forest Management Act and the 2012 National Forest System Land Management Planning Rule (2012 Planning Rule) have allowed the use of project-specific forest plan amendments in order for management activities to adapt to changing conditions and be improved based on new information. Alternative 1 includes two project-specific forest plan amendments. One would incorporate the best available science for restoration in frequent-fire forests (Reynolds et al. 2013), as well as management direction in the revised Mexican spotted owl recovery plan and clarifying language for northern goshawk management. The other amendment would allow ground-based mechanical harvesting with specialized equipment designed for operating on steep slopes. The two proposed amendment are discussed below.

1) Incorporate best available science for restoration in frequent-fire forests (Reynolds et al. 2013), including management direction in U.S. Fish and Wildlife Service's revised Mexican spotted owl recovery plan and clarifying language for northern goshawk management.

   The Carson forest plan provides guidelines to manage for uneven-aged stand conditions but does not provide guidelines for managing interspaces at the fine scale. Recent science (Reynolds et al. 2013) has shown more interspaces were present on the landscape historically, and it is part of the natural fire regime for these interspaces to remain essentially treeless as a result of frequent fires. To meet restoration objectives, there is a need for a project-specific forest plan amendment to include the definition of interspaces, how interspaces and openings relate to vegetation structural stage, and how canopy cover would be measured across the landscape.

There are substantial differences between the 2012 Mexican spotted owl recovery plan and the current forest plan, as well as recent scientific recommendations regarding northern goshawk management, that impede the ability of Carson National Forest personnel to adequately create and maintain sufficient habitat for these two species under the 1986 forest plan. Therefore, a project-specific forest plan amendment would need to address the direction provided in more recent documents. Specifically, this forest plan amendment would:

- update definitions and direction for Mexican spotted owl protected habitat (protected activity centers), recovery habitat, and other forest and woodland types to align with the current recovery plan;
- update language and direction related to prescribed cutting and fire treatments in protected activity centers to be consistent with the current recovery plan;
- add forest structure guidelines for Mexican spotted owl recovery habitat;
- add direction for riparian forest habitats;
- update Mexican spotted owl survey information;
- remove the direction for treating Mexican spotted owl habitat in incremental percentages;
- replace forest plan standards and guidelines for ponderosa pine and dry mixed conifer (including northern goshawk direction) with desired conditions and guidelines;
- convert habitat structure analysis for old growth and vegetation structural stage from three scales of analysis (fine-scale, mid-scale, and large-scale)[3] to one scale of analysis (project-level) to better inform project planning and design;
- add a desired condition for the percentage of interspaces within uneven-aged stands to facilitate restoration; and
- add the desired interspace distance between tree groups.

2) Allow ground-based mechanical harvesting with specialized equipment designed for operating on steep slopes to incorporate the most recent advances in harvest technologies into project implementation.

   Without this project-specific forest plan amendment, the likelihood of meeting the project's purpose and need would be diminished. Within the Pueblo Ridge Restoration project area, there are 2,921 acres of National Forest System lands with slopes of 40 percent gradient or more. These areas exhibit conditions indicating they are prone to active crown fire. Stand improvement thinning in these areas would be necessary before prescribed burns could be safely and responsibly applied, and conducting stand improvement thinning using nonmechanical methods, such as hand treatment, would be labor intensive, impractical, or both. This would result in diminished treatment or no treatment in these areas.

[3] Fine scale is equivalent to an area within a portion of an ecosystem management area. Mid-scale is identified as an ecosystem management area, typically 10,000 to 100,000 acres and delineated based on human values, use patterns, and physical and biological factors such as watershed boundaries. Large scale would consist of an area across adjacent ecosystem management areas.

Mechanized equipment technology has improved since the 1986 forest plan was approved. At the time the forest plan was approved, the use of ground-based mechanized equipment resulted in impacts to slopes greater than 40 percent; for example, damage to stabilizing vegetation and increased erosion. Current technology includes ground-based mechanized equipment, such as harvesters and forwarders, capable of tethering to trees with a winch. The use of this kind of equipment results in fewer impacts than previous equipment types. While use of this equipment is generally more costly than standard equipment, these costs are reasonable and less prohibitive than hand-thinning treatments.

The proposed project includes nine management areas. Relevant standards and guidelines from the 1986 forest plan will be applied for each management area, unless amended by project-specific forest plan amendments as described above.

#### *Alternative 2*

There are no forest plan amendments proposed for alternative 2.

### 1.5.1.2 Vegetation and Fuels Treatments

#### *Alternative 1*

Forest thinning treatments on 9,709 acres would utilize conventional ground-based equipment such as feller-bunchers and skidders, conventional non-ground-based equipment (for example, skyline yarders), harvesters, and forwarders, including those capable of operating on slopes of up to 75 percent gradient with the assistance of winches. Masticators and equipment such as excavators capable of treating and piling fuel on steep slopes would also be utilized where appropriate.

Table 1 below provides detailed information for proposed treatment activities within and outside of fuelbreak treatment areas that are identified as MSO and/or old growth habitat. Prescriptions for proposed activities would adhere to management direction and minimum habitat requirements identified in the 2012 Mexican Spotted Owl Recovery Plan to maintain or reach minimum requirements for each designation for MSO.

**Table 1. Habitat designations within proposed treatment areas**

| MSO and Old-Growth Habitat Components in Proposed Treatment Areas | | Potential Natural Vegetation Forest Types within Pueblo Ridge Project Area | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ponderosa Pine | Douglas-fir | White fir | Spruce-fir | Aspen | Pinyon-Juniper |
| Proposed Treatments in MSO Habitat<br><br>Outside of Proposed Fuelbreaks | Recovery Habitat | | 1,049 acres | | | | |
| | Nest/Roost Habitat | | 203 acres | | | | |
| | Add Nest/Roost Habitat | | 249 acres | | | | |
| | Nest/Roost and Old Growth Habitat | | 209 acres | | | | |
| | Add Nest/Roost and Old Growth Habitat | | 151 acres | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Proposed Treatments in MSO Habitat<br><br>Within Proposed Fuelbreaks | Recovery Habitat | | 729 acres | 595 acres | 26 acres | 214 acres | |
| | Nest/Roost Habitat | | 119 acres | 25 acres | | | |
| | Add Nest/Roost Habitat | | 274 acres | | | | |
| | Nest/Roost and Old Growth Habitat | | 6 acres | | | | |
| | Add Nest/Roost and Old Growth Habitat | | 5 acres | | | | |
| Proposed Treatments in Old Growth Habitat | Outside of MSO Habitat | 653 acres | | | | | 869 acres |

Site-specific prescriptions would be developed during the implementation phase of this project to meet desired conditions while assuring habitat components and structural attributes are met. Table 2 below provides information on potential silvicultural prescriptions that would be considered to meet the purpose and need of the project.

**Table 2. Potential silviculture prescriptions by forest type, habitat, and old growth designations**

| **Proposed Silvicultural Treatments by Forest Type and Habitat Components** | **Estimated Treatment Acres by Potential Natural Vegetation Forest Type** |
|---|---|
| Uneven-aged Management in conifer areas outside of MSO habitat, old growth, aspen, oak, and riparian areas.<br><br>Including but not limited to group selection, individual tree Selection, free thinning, and thin from Below<br><br>Retention levels of 40 – 80 ft²/acre with an average basal area of 60 ft²/acre, | Ponderosa Pine - 1,843 acres<br><br>White fir - 279 acres<br><br>Pinyon-Juniper - 1,484 acres |
| Uneven-aged Management on acres proposed for fuelbreaks (Within MSO Recovery Habitat)<br><br>Including, but not limited to thin from below, free thinning, individual tree selection, weeding, liberation cuts, and small patch cuts.<br><br>Residual retention level of 40% canopy cover. Thin down to a residual basal area ranging from 30 – 120 ft²/acre with majority of average BA within 60ft²/acre. Retention of trees 18" DBH and larger where appropriate. | Douglas-fir – 729 acres<br><br>White fir – 595 acres<br><br>Spruce-fir – 26 acres<br><br>Aspen – 214 acres |
| Uneven-aged Management in Aspen forest type.<br><br>Including but not limited to weeding, liberation cuts, and thin from above | Aspen - 174 acres |

| | |
|---|---|
| Retention of live aspen and at least 3 – 6 large diameter conifers 18" DBH and larger for snag and down-woody materials recruitment | |
| Thin from Below in Old Growth Habitat<br><br>Basal area and tree per acre retention requirements by forest type in Table 1 of Appendix A.<br><br>For Ponderosa Pine: Manage for 20 trees per acre ranging from 14 – 18" DBH/DRC with a total basal area of 70 - 90 ft²/acre.<br><br>For Pinyon-Juniper: Manage for 12 – 30 trees per acre ranging from 9 – 12" DBH/DRC with a total basal area of 6 – 24 ft²/acre. | Ponderosa pine - 653 acres<br><br>Pinyon-Juniper - 869 acres |
| Uneven-aged Management in MSO Recovery Habitat.<br><br>Including but not limited to Group Selection, Individual Tree Selection, Free Thinning, and Thin from Below<br><br>Retention levels of 40% canopy cover. Retention of trees >24" DBH unless considered a threat to human life and property. Thin down to a residual basal area ranging from 35 – 120 ft²/acre with majority of average BA within 60 – 80 ft²/acre. | Douglas-fir – 1,049 acres |
| Uneven-aged Management in MSO Nest/Roost Habitat, Add Nest/Roost Habitat (Also includes acres that overlap with acres proposed for treatment with fuelbreak and old growth designation).<br><br>Including but no limited to free thinning, individual tree selection, and thin from below.<br><br>Minimum basal area retention level of 120 ft²/acre while retaining at least 30% of the basal area in both the 12 – 18" DBH and 18"+ DBH ranges. | Douglas-fir – 1,216 acres<br><br>White fir – 25 acres |

### *Alternative 2*

Forest thinning treatments on 9,709 acres would utilize conventional ground-based equipment, such as feller-bunchers and skidders, conventional non-ground-based equipment (for example, skyline yarders), harvesters, forwarders, masticators, equipment such as excavators capable of treating and piling fuel, and hand thinning and piling. Ground-based mechanical treatments would not occur on slopes greater than 40 percent—a total of 2,921 acres of the project area. Hand thinning and hand piling could occur anywhere on the 9,709 acres of the project area.

## 1.5.1.3 Treatment Activities Common to Both Alternatives

Hand-thinning treatments and cutting of understory ladder fuels (for example, shrubs, conifer regeneration) would occur as needed throughout the project area, along with lop-and-scatter techniques to reduce ladder fuels. Commercial and personal-use Christmas tree sales would also occur in areas that meet guidelines for Christmas tree harvesting.

Hand and machine piling and burning would occur throughout the project area where not restricted by slope as an option to reduce natural and activity-created fuels. Remaining trees in treatment

units would be pruned 8 to 10 feet high, where necessary, to raise tree canopy base heights. Small trees would be cut as needed to create a burnable fuel bed prior to prescribed fire.

Availability of fuelwood on up to 9,709 acres would include dead and down fuelwood harvesting, where appropriate, and cutting and decking, where appropriate. This would be conducted off designated temporary roads and would include off-road travel to specific fuelwood-cutting areas. Fuelwood would be cut, removed, and decked away from riparian areas and slopes with a gradient greater than 40 percent. Fuelwood harvesting activities would cease once temporary roads are closed following thinning activities. Public firewood collection would be offered as part of this treatment type.

Throughout the project area, prescribed burning (including broadcast, jackpot, under-burning, pile burning, and other common acceptable methods) is proposed to reduce surface, ladder, and canopy fuels and break up contiguous vegetation. Prescribed fire and other fuels reduction treatments, such as mastication and chipping, would be applied throughout the project area to reduce and maintain appropriate levels of surface, ladder, and crown fuels. This would be conducted using a variety of ignition methods on a schedule that would mimic natural fire return intervals. Units would be burned with varying fire intensities resulting in mixed-severity fire effects and creating a mosaic of burned and unburned patches. Prescribed fire could occur before or after initial thinning treatments are completed to afford fire managers flexibility with implementation. Multiple entries of prescribed fire would be needed to maintain post-treatment conditions and to mimic historical fire return intervals to restore fire to fire-adapted ecosystems.

Mastication treatments, including the use of boom-mounted masticators, would occur, where appropriate, across the project area to reduce fuels. Chipping residual fuels and biomass in conifer stands would be included as an option to reduce fuels prior to prescribed fire.

## 1.5.2 Restoration Treatments

### 1.5.2.1 Both Alternatives

Up to 10.5 miles (approximately 32 acres) of riparian restoration treatments along streams within the project area and adjacent to the Rio Fernando in the La Sombra and Capulin Campgrounds would improve riparian habitat (see figure 2). Treatments could include conifer removal, ladder fuel reduction, and interconnected canopy reduction. Aspen restoration treatments would occur on 481 acres throughout the project area including in the fuelbreaks. These treatments would selectively remove conifers within aspen stands and within 150 feet of aspen stands to increase aspen regeneration.

Treatments may be performed mechanically with machinery such as a self-leveling feller buncher with a cutting and delimbing head or a mastication head. Other treatments would entail hand thinning, lopping and scattering materials, or piling and burning materials outside of the riparian zone. All treatment methods would follow best management practices. Fuels remaining on site would be treated through prescribed fire or mechanical means to further promote aspen regeneration.

## 1.5.3 Road Management

### 1.5.3.1 Alternative 1

No new permanent roads would be constructed under this alternative. With the proposed forest plan amendment, steep-slope mechanized equipment would be used to access treatment areas; for example, steep-slope cut-to-length harvesters and forwarders with the capability of tethering to trees with a winch.

### 1.5.3.2 Alternative 2

Up to 5 miles of new permanent road would be constructed to access units in the southeastern portion of the project area. The new road would be used for project activities but would be closed to the public without written authorization or permit. The road would be closed after project implementation (see Figure 6).

### 1.5.3.3 Both Alternatives

Proposed road management includes rerouting some existing roads, decommissioning and closing 13 or more miles of existing roads after project implementation, constructing approximately 5 miles of temporary road, and maintaining current National Forest System roads for project activities. Temporary roads are roads necessary for emergency operations or authorized by contract, permit, lease, or other written authorization; they are not forest roads and are not included in a forest transportation atlas (36 CFR 212.1). Rerouting existing system roads and up to 5 miles of temporary road construction would occur during implementation to allow access to thinning units. The temporary roads would be decommissioned once the project is completed.

Road maintenance would occur on approximately 5 miles of roads currently open to the public and on 39 miles of administratively managed roads currently closed to the public. Part of the North Boundary Trail is proposed for a haul route. Decommissioning of 13 or more miles of closed roads would be included to reduce erosion from current road conditions. Decommissioning may be accomplished through a variety of methods, including but not limited to, abandonment, scarifying, revegetation of roadbeds, recontouring of roadbeds, installation of dirt or stone barriers, scattering of activity-generated large woody debris on roadbeds, or a combination of these things. Decommissioned roads would be removed from the national forest road system. They would continue to be tracked in the transportation atlas for future reference. The roads proposed for decommissioning do not include roads needed for grazing or other permittee access, fire suppression, or administrative access for forest management.

## 1.5.4 Range Improvements

### 1.5.4.1 Alternative 1

Range improvement activities include up to nine spring developments, two guzzlers, and one corral. Likely spring development locations are shown in Figure 5, but may occur anywhere in the Capulin allotment. The springs would be fenced with wildlife-friendly fencing, and water would be piped to drinkers outside fenced areas. The corral would be built to improve livestock distribution on the Capulin allotment.

### 1.5.4.2 Alternative 2

Range improvement activities include up to four spring developments, two guzzlers, and one corral. Likely spring development locations are shown in Figure 6, but may occur anywhere in the

Capulin allotment. The springs would be fenced with wildlife-friendly fencing, and water would be piped to drinkers outside of fenced areas. The corral would be built to improve livestock distribution on the Capulin allotment.

## 1.5.5 Comparison of Alternatives

Table 3 displays the actions that differ between alternatives. The acres of mechanical treatment are also included. Instead of a forest plan amendment to allow tracked and wheeled logging equipment to operate on steeper slopes (alternative 1, see figure 3), alternative 2 includes 5 miles of new permanent road to allow logging machines with long cables (skyline yarders) to access proposed treatment areas and complete the vegetation treatments as proposed. This means both alternatives could achieve the same amount of vegetation treatment. The analyses in the "Environmental Impacts of the Action Alternatives" section assumes this and discloses the impacts. While alternative 2 assumes all the acres would be treated, the 2,921 acres of slopes greater than 40 percent under alternative 2 (figure 4) may not be treated if funds are unavailable to pay for the costs of the new permanent road.

The following actions are the same under both alternatives:

- mechanical treatment on slopes less than 40 percent slope
- hand-thinning with chainsaws and lopping and scattering activity-created fuels, piling activity-created fuels, or both
- limbing leave trees 8 to 10 feet high and cutting understory ladder fuels (shrubs, brush, conifer regeneration) where needed
- commercial Christmas tree sales
- harvesting dead and down fuelwood
- prescribed fire treatments (broadcast, under-burning, jackpot burning, pile burning) and maintenance burning to mimic natural fire return intervals
- temporary road construction
- haul route maintenance
- decommissioning roads
- new guzzlers
- new corral
- riparian restoration and aspen restoration treatments

**Table 3. Differences in alternatives**

| Activities | Alternative 1, Proposed Action, Forest Plan Amendments | Alternative 2, No Forest Plan Amendments |
|---|---|---|
| Amendment | Incorporate best available science for restoration in frequent-fire forests (Reynolds et al. 2013), including management direction in the revised (2012) Mexican spotted owl recovery plan and clarifying language for northern goshawk management. | No amendment<br><br>Will follow management direction with in the 1996 Mexican spotted owl recovery plan. |
| Amendment | Provide for ground-based steep-slope treatments on slopes greater than 40 percent and less than or equal to 75 percent gradient. | No amendment |
| | This would allow for mechanical thinning to occur on up to 2,921 acres. | Hand thining of up to 2,921 acres. |
| | Removal of thinned material and biomass could be removed from the site using mechanical means such as a forwarder. | Removal of thinned material could be removed via a skyline yarder, or left on-site to be treated with hand piling and burning activities. |
| Mechanical treatment utilizing conventional ground-based equipment such as feller-bunchers and skidders, conventional non-ground-based equipment (skyline yarders), harvesters and forwarders, masticators, and equipment such as excavators. | 9,709 acres (entire project area) | 9,709 acres (2,910 acres with slopes greater than 40 percent would rely solely on the proposed road construction and skyline yarders to be mechanically treated) |
| Mastication treatments (including boom-mounted masticators) | 9,709 acres | 6,799 acres |
| Hand thinning (to include fuelwood availability) | 9,709 acres | 6,799 acres |
| Chipping and biomass mastication in conifer and oak areas (fuel treatment) | 9,709 acres | 6,799 acres |
| Riparian Restoration | Up to 10.5 miles | Up to 10.5 miles |
| New permanent road construction | 0 miles | Up to 5 miles |
| Temporary road construction | Up to 5 miles | Up to 5 miles |
| Decomissioning of roads | 13 miles minimum | 13 miles minimum |

| Activities | Alternative 1, Proposed Action, Forest Plan Amendments | Alternative 2, No Forest Plan Amendments |
|---|---|---|
| Spring developments (range improvements) | 9 | 4 |
| Guzzlers | 2 | 2 |
| Corrals | 1 | 1 |

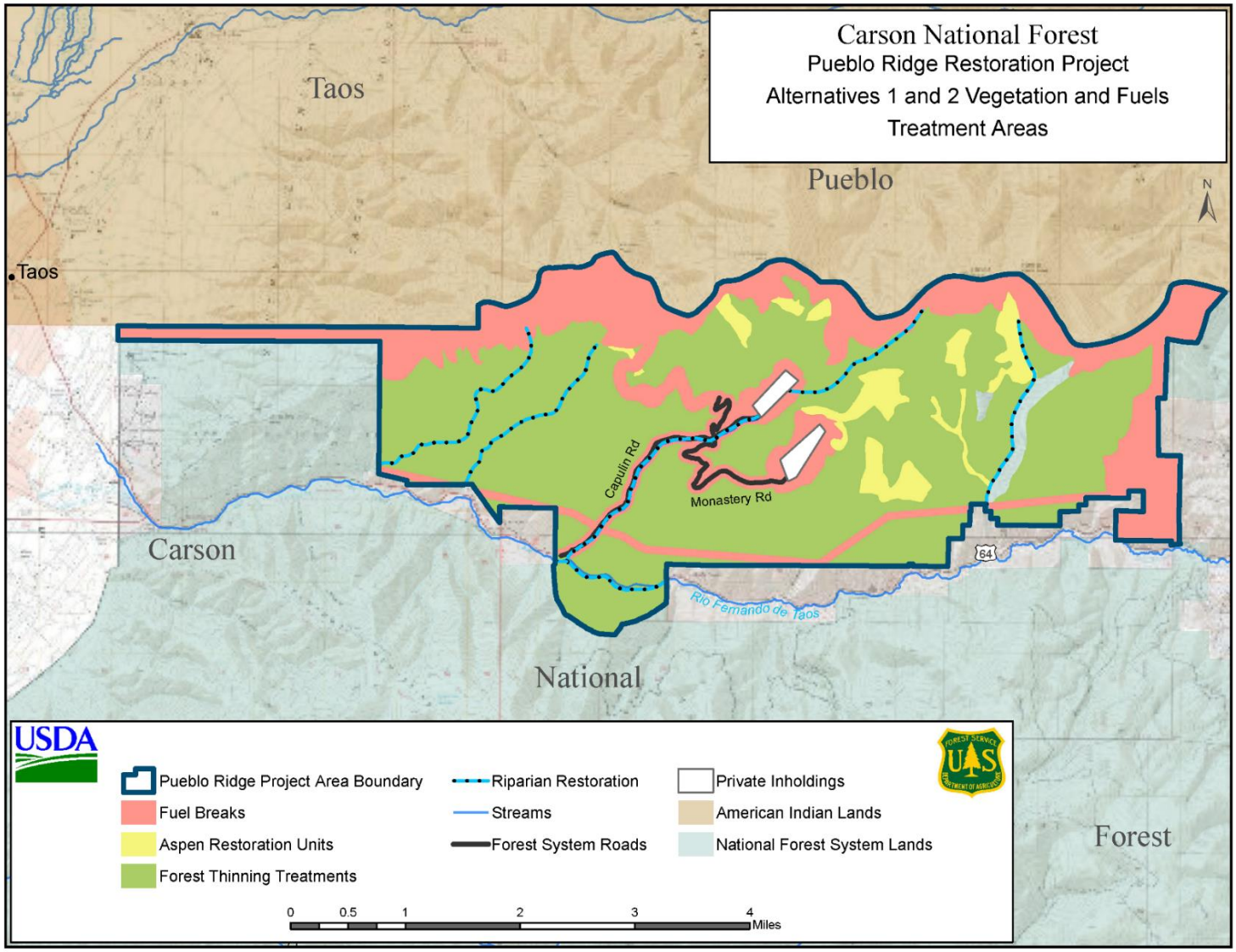


**Figure 2. Overview map of proposed treatments areas for the Pueblo Ridge Restoration Project**

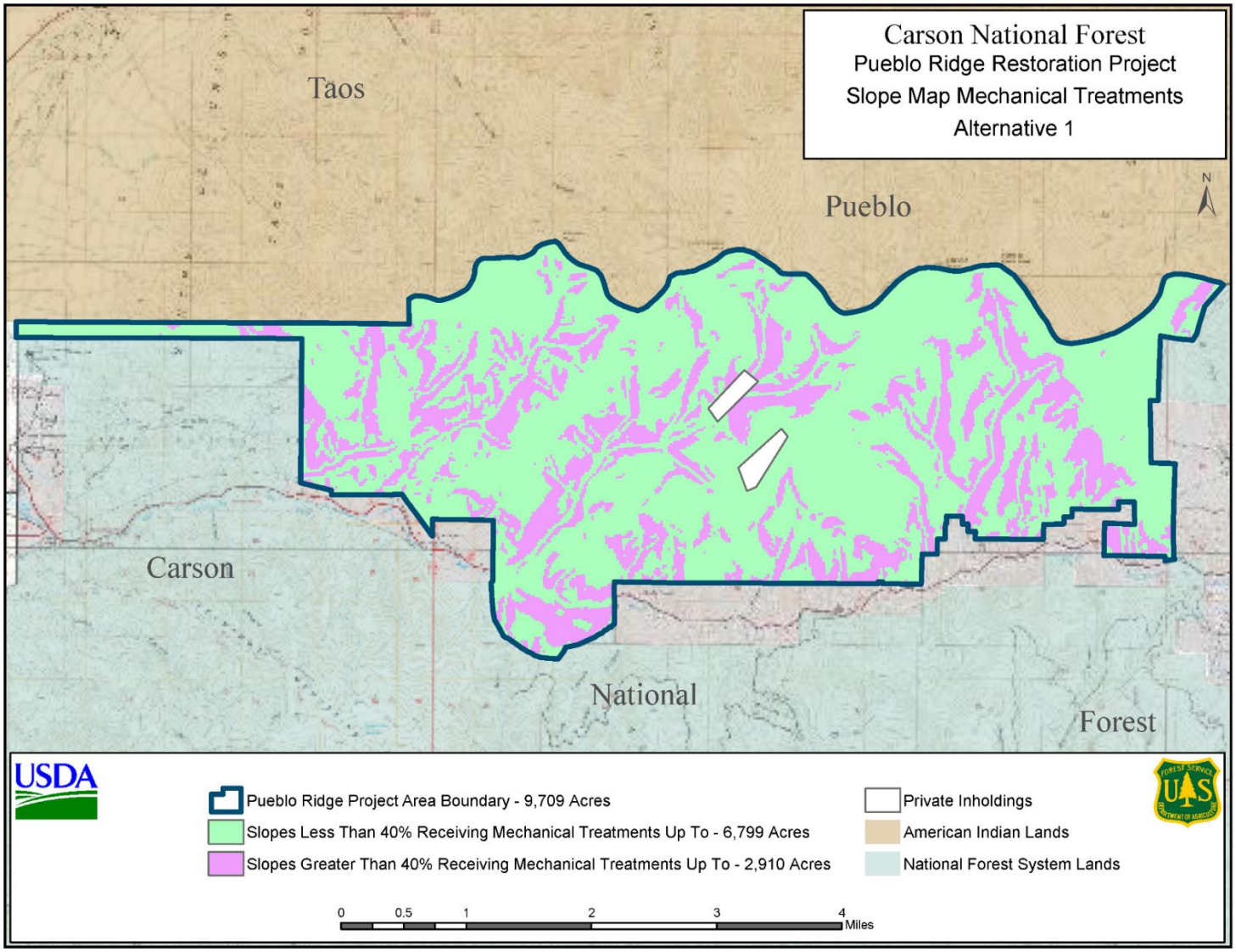


**Figure 3. Alternative 1 slope map showing mechanical treatments**

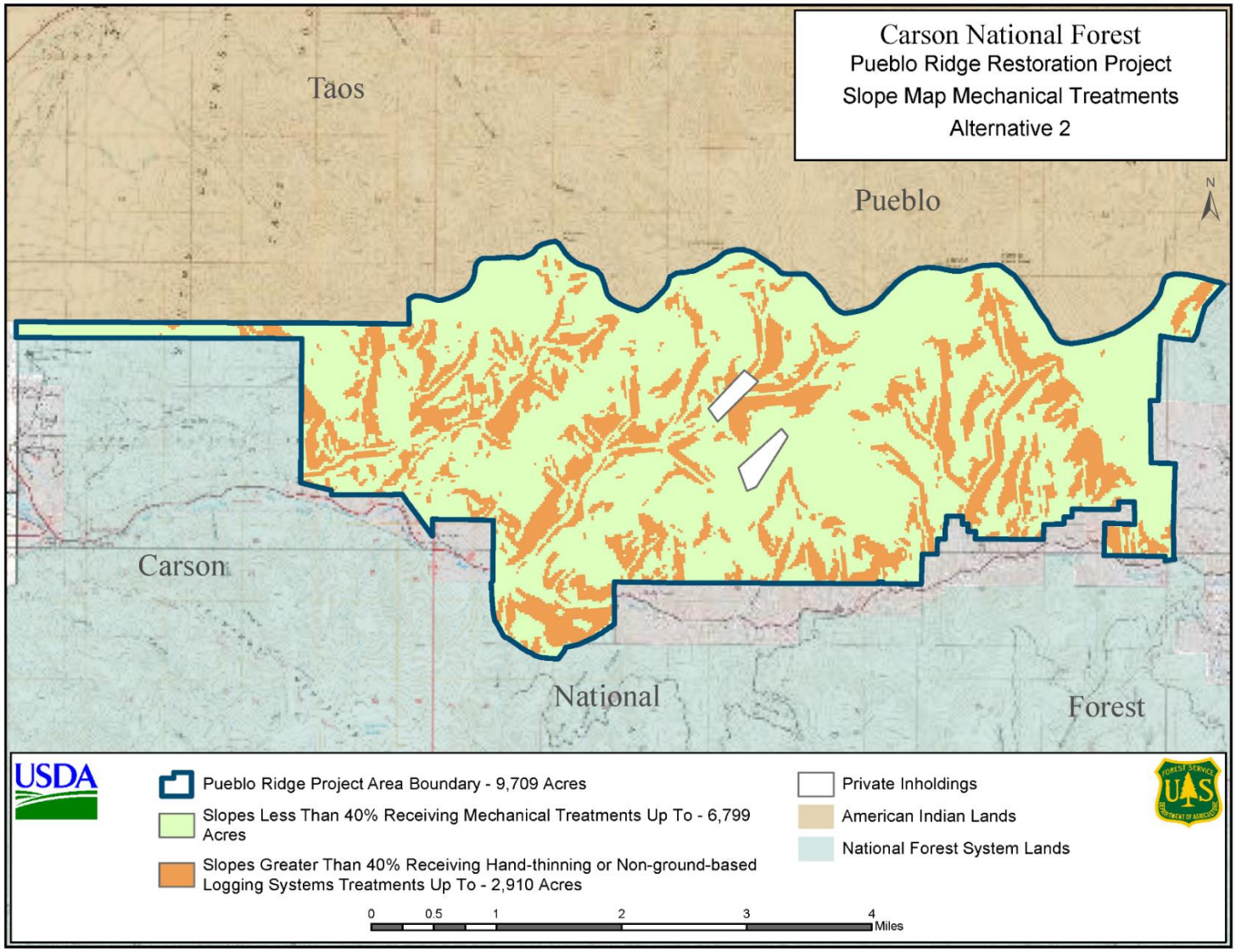


**Figure 4. Alternative 2 slope map showing mechanical treatments**

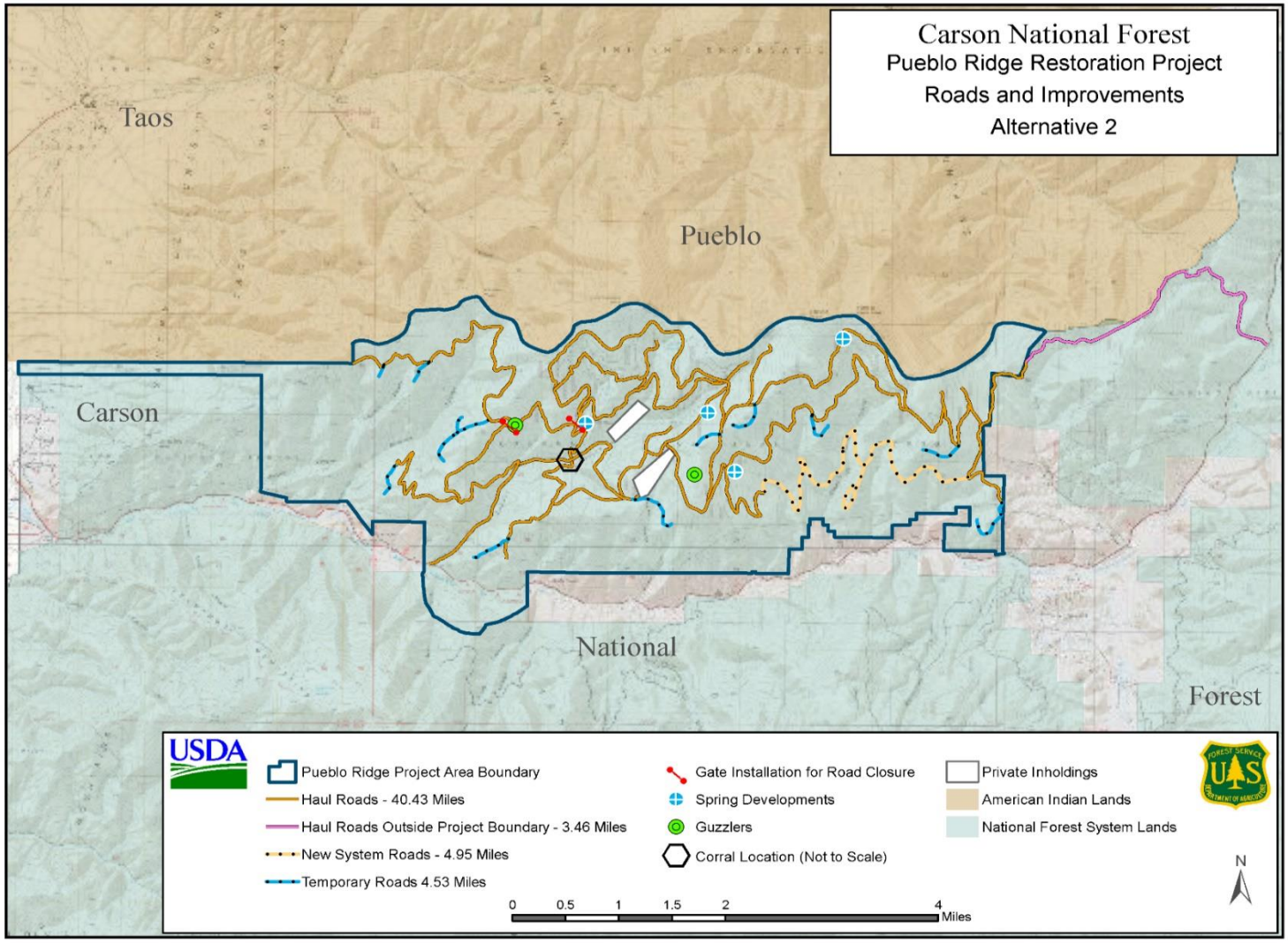


**Figure 5. Alternative 1 potential roads and improvements**

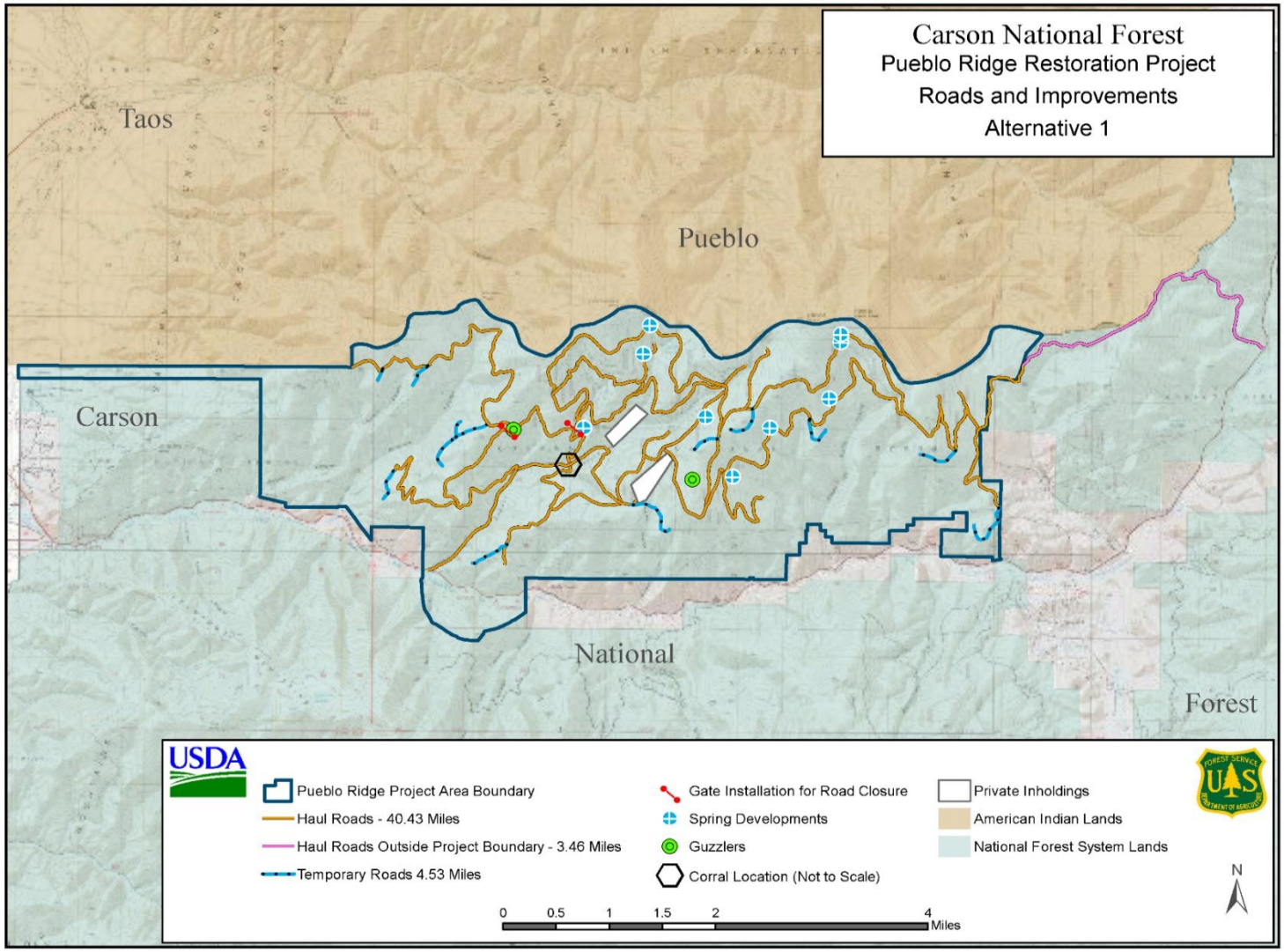


**Figure 6. Alternative 2 potential roads and improvement**

# 1.6 Project Design Features

Project design features would be incorporated into the project to protect soil, water, scenery values, terrestrial and aquatic habitat, and heritage resources. Mitigation measures and best management practices would be implemented during the project to limit erosion and sedimentation, reduce impacts to terrestrial and aquatic species, protect heritage resources, prevent the introduction and spread of invasive plants, and protect public health and safety.

The following design features are an integral part of this project and would be carried out as part of the selected alternative. Design features are site-specific elements developed to further define and guide the proposed action.

## 1.6.1 Project Design Features Common to Both Alternatives

### 1.6.1.1 Silviculture

- Slash at landings would be machine-piled for future burning or masticated if the material cannot be used for biomass or fuelwood.
- Where available, a minimum of 20 percent of each forest type within the project area would be allocated for old growth management (see figure 7). Vegetation treatments and prescribed burning can occur in the allocated areas provided the treatments 1) enhance old growth characteristics and 2) do not reduce the allocated areas below the minimum thresholds set for both high-quality or low-quality old growth.
- Vegetation structural stage 6 (old and large) trees would be retained unless they compromise the health of aspen stands, they compromise general forest health, or they pose a risk to public safety. This would be evaluated and determined on a stand-by-stand or tree-by-tree basis during implementation.
- Silvicultural prescriptions would account for an additional 5 to 15 percent loss of trees from subsequent prescribed burning within treatment units.
- Existing snags would be designated as leave trees outside landing areas or where they do not otherwise pose a safety hazard. Two to three large (greater than 18 inches in diameter at breast height) live trees would be retained per acre as recruitment snags in areas where snags are deficient to meet forest plan direction of retaining 300 snags per 100 acres. Live trees with dead tops or lightning scars would be top priority for retention as future snags. Three snags per acre would be retained around meadows.

### 1.6.1.2 General Wildlife

- Dead and dying snags would be retained within all treatment units at a ratio of at least 300 snags per 100 acres of suitable timberland, except in areas where they present a risk to human safety.
- Snags could be recruited from disease-free cull or poor-form trees within at least 100 feet of ponds, lakes, springs, seeps, wet meadows, and openings, where appropriate and beneficial to wildlife.
- Known raptor nests (besides Mexican spotted owl and northern goshawk which have species-specific mitigation measures below) would be buffered from mechanical treatments according to forest plan guidance.

- When designing timber sales, attempts would be made to keep activity perimeters within one major drainage at a time. Subdivision design of timber sale units and contract stipulations (such as requiring the completion of a block before beginning activities in another area of the sale) would be utilized as necessary to minimize big game disturbance.
- Sufficient size and length per 100 acres of down logs (where biologically feasible) on 75 percent of suitable timberlands not determined to be highly vulnerable to fuelwood collection would be retained. The guideline includes:
    - Conifers: 12-inch minimum diameter and 5,000 linear feet per 100 acres.
    - Aspen: 10-inch minimum diameter and 3,300 linear feet per 100 acres.
- Timber sales would be designed so activity time frames would minimize displacement of wildlife. A primary objective would be to limit logging disturbance in an activity area to no more than three years whenever possible on each timber sale.
- Retain some Gambel oak with diameter at root collar greater than 8 inches where desired for wildlife habitat, unless the retention of these trees compromises the purpose and need of this project.

#### 1.6.1.3 Mexican spotted owl

- Surveys for presence of nesting Mexican spotted owls would be conducted prior to activities occurring within suitable nesting habitat. If implementation of the project occurs more than five years after the pre-implementation surveys, an additional one year of survey would be conducted in compliance with the recovery plan, using the accepted protocol prior to implementation. If owls are detected, consultation with U.S. Fish and Wildlife Service personnel would be reinitiated.
- Surveys and implementation activities can be phased to ensure recent surveys are conducted prior to conducting treatments.
- If owls are detected[4], a minimum 600-acre protected activity center would be delineated, which also includes a 100-acre core or activity center area (alternatives 1 and 2, respectively). Human activity would be limited or deferred within core areas or established protected activity centers (alternatives 1 and 2, respectively) from March 1 to August 31, if these areas are occupied by owls.
- Road building in protected activity centers should be avoided, unless unavoidable management reasons (for example, safety concerns) necessitate road construction. Consultation with U.S. Fish and Wildlife Service personnel would be reinitiated if road construction is deemed necessary inside a protected activity center.
- Within protected activity centers, removal of hardwoods, down woody debris, snags, and other key habitat variables should occur only when compatible with owl habitat management objectives as documented through reasoned analysis. Otherwise, levels of these materials should be improved or maintained.

[4] Mexican spotted owl protected activity centers do not currently exist within the project area. Should the need arise to establish a protected activity center during project implementation, this project design feature would apply.

- Prescribed fire within protected activity centers (excluding activity center areas in alternative 2), such as light burning of surface and low fuels, is permitted outside the breeding season pending review by specialists to ensure habitat protection.

#### 1.6.1.4 Northern goshawk

- Surveys for presence of nesting northern goshawks would be conducted prior to activities occurring within suitable nesting habitat. If implementation of the project occurs more than five years after the pre-implementation survey, an additional one year of survey would be conducted prior to implementation. Surveys and implementation activities can be phased over time to ensure surveys are complete before implementation activities begin.
- If an active northern goshawk nest is found in pre-implementation surveys, appropriate management guidelines for habitat disturbance mitigations would be employed, including:
  - establishment of a post-fledging family area of at least 600 acres
  - northern goshawk timing restrictions (March 1 to September 30) would be applied to management activities within post-fledging family areas and nest stands
  - trees containing active and alternative nest sites, as well as some adjacent trees, would be retained

#### 1.6.1.5 Fire and Fuels

- Prescribed fire control lines would be constructed as needed to protect resources, hold prescribed fires in predetermined areas, or both. Control lines include black line, hand line, dozer line, fire line, pruning, and saw line. Existing roads and topographic features, such as trails, creek drainages, meadows, rocky outcrops, and other natural barriers, would be used as control lines where possible.
- Hazard trees and snags would be removed where they pose a risk to the public or national forest personnel.
- Prescribed fire operations would occur when weather and fuel conditions are favorable and risk of fire escape is low. All burning would take place under the guidelines in the prescribed fire plan, which would be developed specifically for all project-related burning activities. Prescribed fire plans would address parameters for weather, air quality, contingency resources, and potential escapes.
- Surface fuel loading levels of coarse woody debris less than 3 inch in diameter would be reduced to approximately 5 to 10 tons per acre in areas determined by local fire managers in fuelbreaks.
- Surface fuel loading levels of coarse woody debris greater than 3 inch in diameter would be reduced to approximately 10 to 15 tons per acre, in areas determined by local fire managers adjacent to private land and in fuelbreaks.
- Prescribed burns will be registered with the New Mexico Environment Department, Air Quality Bureau, in advance of prescribed burn implementation to ensure conformity with state implementation plans for emissions of regulated air pollutants from National Forest System lands or facilities.

### 1.6.1.6 Watershed

*Streamside Management Zones*

- Streamside stream and riparian management zones would generally not exceed 300 feet, except under extreme circumstances, such as steep, dissected, highly unstable slopes adjacent to channels.
- Stream and riparian management zones would be delineated by the watershed specialist based on channel and adjacent upland conditions. These zones would be delineated using the following criteria:
    - ♦ No personal-use fuelwood harvest would be conducted within 100 feet of running surface water.
    - ♦ Skid trails, landings, and temporary access roads would be excluded from riparian zones, meadows, wetlands, and other sensitive areas.
    - ♦ Woody vegetation that is stabilizing streambanks would be left in place.
- Stream and riparian management zones would be designated on a map.
- Broadcast burning would not be initiated within riparian areas but would be allowed to move into and through riparian areas.
- Excessive vehicle traffic would be deterred from riparian zones, meadows, wetlands, and other sensitive areas.
- Where stream crossings occur, operational activities would be scheduled during low-water periods, and stream-hardening structures would be installed, where appropriate, to minimize sediment generation and delivery to streams.
- Erosion control structures, such as culverts, water bars, etc., would be constructed to not divert runoff directly into stream channels.
- Residual woody debris (slash) generated from treatment activities would be removed from stream channels, including ephemeral streams and drainages.
- Stream and riparian management zones not mapped but encountered in the field during operations would adhere to the guidelines above.

### 1.6.1.7 Existing Haul Roads

- The road surface drainage system would intercept, collect, and remove water from the road surface and surrounding slopes in a manner that reduces concentrated flow in ditches, culverts, over-fill slopes, and road surfaces.
- Road surface treatment would support wheel loads, stabilize the roadbed, reduce dust, and control erosion consistent with anticipated traffic and use.
- All roads would be maintained with proper road maintenance practices during and after treatment activities.

### 1.6.1.8 Temporary Road Construction

- The Carson National Forest terrestrial ecosystem survey would be consulted for potentially unsuitable soils and terrain, and roads would be located to fit the terrain, follow natural contours, and avoid steep grades.
- Potential areas of concern (seeps, springs, meadows, riparian-wetland areas, stream crossings) would be field verified with a watershed specialist. The road surface drainage system would be designed to intercept, collect, and remove water from the road surface and surrounding slopes in a manner that reduces concentrated flow.
- The road would be designed for minimal disruption of natural drainage patterns and to reduce the hydrologic connection of the road segment or network with nearby waterbodies.
- Sensitive areas, such as riparian areas, wetlands, meadows, bogs, and fens, would be avoided to the extent practicable.
- Outfalls of road surface drainage structures would be located to provide sufficient buffer distance for water to infiltrate prior to reaching a stream and limit the number and length of water-crossing-connected areas to the extent practicable.
- Construction activities would be scheduled to avoid direct soil and water disturbance during periods of the year when heavy precipitation and runoff are likely to occur.
- Erosion and stormwater controls would be installed and maintained as necessary to ensure proper and effective functioning (sediment filters, straw bales, or wattles).
- Stream crossings would be designed to avoid or minimize adverse effects to soil, water quality, and riparian resources.

### 1.6.1.9 Decommissioning of Temporary Roads

Temporary roads would be decommissioned by one or more of the following:

- Pulling berms; pulling slash (where available); placement of slash, water bars, and rolling dips; and planting or seeding disturbed areas to achieve a minimum of 50 percent ground cover.
- Mulching and restoring natural drainage patterns (may include pulling water bars and culverts).
- Disguising the first hundred yards of travelway with large pieces or organic material such as cull logs and tops of trees. Methods for individual roads would be determined in consultation with the watershed specialist.
- Recontouring slopes and subsoiling and scarification of compacted soils to a depth of 16 inches (unless prevented by bedrock or rock content of soil).

### 1.6.1.10 Fueling and Vehicle Maintenance

- Refueling and vehicle maintenance and staging areas would occur in upland sites at least 200 feet from any stream or riparian area. If this is not practical, the watershed specialist would preapprove staging areas, and spill containment materials would be required on- site.
- Spill prevention, containment, and countermeasure plans are required if the volume of fuel exceeds 660 gallons in a single container or if total storage at a site exceeds 1,320 gallons.

#### 1.6.1.11 Timber Harvest and Commercial Products – Skidding

- Skidding would occur when the ground is dry, frozen to a depth of 6 inches, soil is armored with a minimum of 8 inches of packed snow, or soil is snow covered with a minimum of 16 inches of unpacked snow.
- Work would occur only when the soil moisture is such that the soil surface is stable and not susceptible to damage.
- Work would be suspended when soil moisture content warrants; for example, no skidding would be done under wet soil conditions, when ruts six inches or deeper would form on a continuous 50 feet or more of skid trails.
- Ground equipment operations would be avoided on unstable, wet, or easily compacted soils and on steep slopes unless operations can be conducted without causing excessive rutting, soil puddling, or runoff of sediments directly into waterbodies.
- No skidding or vehicular equipment would be allowed in moist or wet meadows, wetlands, or other sensitive areas.
- If the only way to log a particular part of a unit is to skid in the draw bottom, that part of the unit would be excluded from harvest.
- Equipment would be permitted in ephemeral draw bottoms only at designated crossings.
- Skid trails would minimize the number of crossing on the draws and crossing would be at a 90-degree angle.
- Skid trails would be designed to minimize the number of passes, and generally skid trails and landings would occupy less than 15 percent of a treatment unit, unless it is a cut-to-length unit, in which case, skid trails and landings would occupy less than 20 percent of a treatment unit.
- Existing skid trails, roads, and dozer lines would be used where possible. Skid trail spacing would be dictated by the layout of group selection treatments, with a desired spacing of 100 to 120 feet apart for conventional skidder trails and 50 feet apart for cut-to-length forwarder trails, where practicable.
- Skid trails should average less than 14 feet wide.
- Skidders would operate on slash, where possible, to minimize compaction.
- Skid trails would be evaluated after harvest to determine if subsoiling and scarification are needed to break up compaction.
- Skid trails with disturbed soil would be seeded with native grasses (seed mix would be specified in the timber sale contract).

#### 1.6.1.12 Timber Harvest and Commercial Products – Landings

- The size and number of landings would be minimized as practicable to accommodate safe, economical, and efficient operations.
- Existing landings would be reused where their location is compatible with management objectives and water quality protection.
- Landings would be rehabilitated through the following actions: the surface would be reshaped to promote dispersed drainage; suitable drainage features would be installed, soil compaction would be mitigated to improve infiltration and revegetation conditions, soil protective cover would be applied on disturbed areas where natural revegetation is inadequate to prevent accelerated erosion before the next growing season, and native grasses would be seeded.

#### 1.6.1.13 Timber Sale Contract

- Appropriate contract provisions and regional or local provisions would be used to address measures and responsibilities consistent with the best management practices in the decision document in the timber sale contract.
- All protected or excluded areas, including stream and riparian management zones, meadows, wetlands, and waterbodies, would be delineated on the sale area map or project map.
- Approved water-drafting locations and staging areas would be delineated on the sale area map or project map.

#### 1.6.1.14 Thinning Units

- Mechanized thinning equipment would operate under conditions described for tractor skidding, forwarders, or excaliners (a modified excavator that can anchor to the ground with its bucket and utilize skyline yarding techniques in backcountry areas) to minimize soil compaction and displacement.

#### 1.6.1.15 Mastication and Chipping

- Mechanized thinning equipment would operate under conditions described for tractor skidding to minimize soil compaction and displacement.
- Equipment would operate on slash, to minimize compaction where mastication or other mechanical slash disposal treatment occurs, and would limit the accumulation of chunked, chipped, or shredded wood to an average maximum of 4 inches deep or less to allow for vegetative re-growth.

#### 1.6.1.16 Personal-Use Products Units

- Off-highway vehicle use would be monitored to identify areas contributing or likely to contribute to water quality degradation.
- Corrective action may include signing or barriers to redistribute use, placing restrictions on areas, rotation of use on areas, closure to vehicles that are causing problems, or total closure.
- Where soil condition is less than satisfactory or where erosion hazard is severe, areas would not be open to public fuelwood collecting to limit the amount of soil disturbance.

#### 1.6.1.17 Jackpot Burning

- Burning would generally occur when the ground is frozen, partially snow covered, or after monsoon rains have increased soil moistures to minimize scorching the organic soil layer and to maintain large woody material for nutrient cycling.

#### 1.6.1.18 Pile Burning

- Size of burn piles constructed by hand would not exceed approximately 16.5 feet in diameter.
- Burn piles constructed by machine that exceed 16.5 feet in diameter would avoid the use of logs greater than 6 to 8 inches in diameter, pile materials with cut ends facing out of the pile, pile larger logs on top of pile to ensure proper consumption and minimize potential for smoldering to reduce effects on underlying soils. [5]
- Pile burning would not occur within streamside management zones, except over snow or on frozen ground.

#### 1.6.1.19 Timing of Activities

- Noncommercial and commercial activities would be scheduled to minimize the spatial and temporal extent of ground-disturbing activities.
- Roads, skid trails, and landings would be closed and rehabilitated immediately following the cessation of activity to minimize the spatial and temporal extent of ground-disturbing activities.

#### 1.6.1.20 Weeds

- All heavy equipment would be cleaned prior to entering National Forest System lands.
- Seed, straw, and other materials used for road decommissioning and erosion control would comply with "Guidelines for Weed-Free Seed, Mulch, and Fill Materials in Region 3."
- Gravel, fill, sand, and rock utilized in road construction or maintenance would comply with "Guidelines for Weed-Free Seed, Mulch, and Fill Materials in Region 3."
- Native plant materials would be used for revegetation unless accepted extenuating circumstances are identified.

#### 1.6.1.21 Spring Developments

- Locate the water trough, tank, or pond a suitable distance from the spring to avoid or minimize adverse effects to the spring and wetland vegetation from livestock trampling or vehicle access.
- Locate the spring box to allow water to flow by gravity from the spring to the spring box to eliminate disturbance from pumps and auxiliary equipment.

[5] From Pile Burning Lessons Learned website, https://fireadaptednetwork.org/pile-burning-lessons-learned/

- Design the collection system to avoid, minimize, or mitigate adverse effects to the spring development and downstream waters from excessive water withdrawal, freezing, flooding, sedimentation, contamination, vehicular traffic, and livestock as needed.
    - ♦ Collect no more water than is sufficient to meet the intended purpose of the spring development.
    - ♦ Ensure enough water remains in the spring to support the source groundwater-dependent ecosystem and downstream aquatic ecosystems.
    - ♦ Avoid or minimize sediment or bacteria from entering the water supply system.
    - ♦ Trap and remove sediment that does enter the system.
    - ♦ Intercept the spring flow below the ground surface upslope of where the water surfaces.
    - ♦ Size the spring box appropriately to store the expected volume of sediment generated between maintenance intervals, to store enough water for efficient operation of the system, and to provide access for maintenance and cleaning.
    - ♦ Avoid or minimize backing up spring flow by providing overflow relief sized to carry the maximum flow expected from the spring during periods of wet weather.
    - ♦ Use suitable measures to avoid or minimize erosion at the overflow outlet.
    - ♦ Maintain fish and wildlife access to water released below a spring development.
- Construct the spring development in such a manner to avoid or minimize erosion, damage to vegetation, and contamination.
    - ♦ Divert all surface water away from the spring to the extent practicable to avoid or minimize flooding near the spring development.
    - ♦ Use suitable weed-free seed mixes, native plant species, and commonly accepted establishment techniques for wet conditions to cover or revegetate disturbed areas near springs.
- Operate and maintain the spring development and associated water storage in such a manner as to provide water of sufficient quantity and quality for the intended uses and avoid or minimize failure of infrastructure causing concentrated runoff and erosion.
    - ♦ Use suitable measures to manage uses, such as livestock grazing and vehicle traffic, around the spring development to avoid or minimize erosion and sedimentation affecting the spring.
    - ♦ Avoid heavy vehicle traffic over the uphill water-bearing layer to avoid or minimize compaction that may reduce water flow.
    - ♦ Use suitable measures to avoid or minimize overflow of water trough, tank, or pond.
    - ♦ Periodically monitor the spring development and promptly take corrective action for sediment build-up in the spring box, clogging of outlet and overflow pipes, and damage from animals.

### 1.6.1.22 Recreation

- Treatment timing limitations would be coordinated to minimize impacts to the recreating public, concession operators, and special use permit holders. This may include a limited operating period from Memorial Day to Labor Day within recreation sites, no project activities or hauling activities on weekends or holidays, or other site-specific considerations.
- Project implementation would be coordinated with Carson National Forest recreation staff, public affairs officer, and law enforcement personnel to ensure the public is well informed of treatment schedules and potential impacts. Provide public notifications of project activities (for example, logging, hauling, prescribed burning) at major access roads, in local newspapers, and online.
- Warnings and other signing, in accordance with Forest Service signing standards, would be provided to provide for public safety.
- Roads would be restricted or temporarily closed in active project areas (in coordination with Carson National Forest staff) to provide for public safety.
- For treatments within developed campgrounds, a recreation specialist would be consulted to identify trees to be maintained for screening, shading, campground aesthetics, and to identify hazard trees for removal.
- Where trail routes (North Boundary nonmotorized trail and Capulin motorized trail) are within or along the boundary of treatment units or are used as haul routes, the trail routes would be clearly marked and maintained, and hazard trees along the trail would be removed. If treatment operations cross or damage the trail tread, the trail would be reestablished to the appropriate design standards when implementation is complete.
- Hand or machine-made fire lines, skid trails, and temporary roads that are visible from, or intersect, open roads would be obliterated, obscured, or physically blocked to prevent unauthorized off-highway vehicle use.
- Public notification of fuelwood gathering opportunities associated with the project would be provided.
- Following project implementation, the portion of the North Boundary Trail used as a haul route would be restored to its original function as a nonmotorized trail with limited, administrative motor vehicle use authorized. Additionally, at that time, the parts of the trail that are no longer required for administrative use would be returned or converted to single-track trail.

### 1.6.1.23 Visual Quality Management

Standard management requirements for visual quality should be applied within the immediate foreground of sensitive travel routes and use areas (300 feet from the viewer) (Forest Service Manual 2382.1). These include:

- Treatments in the immediate foreground of the Enchanted Circle Scenic Byway (Highway 64), should be natural in appearance, including disposal of all activity-produced slash occurring within the immediate foreground (100 to 300 feet) either during operations or immediately afterwards, as well as revegetation to include 15 percent native wildflower seed within 100 feet of the Enchanted Circle Scenic Byway.

- Post-thinned stands should be predominantly natural in appearance. In areas of roaded natural classification on the recreation opportunity spectrum, modifications may be evident but should be in harmony with the natural environment. In semi-primitive motorized areas, modifications should blend with the surrounding landscape character.
- Landings and skid trail locations: To the extent feasible, locate landings and primary skid trails away from the immediate foreground of sensitive travel corridors. Limit size of landings so they are not visually evident from the sensitive travel routes following completion of treatment activities.
- Stump heights: Minimize stump heights in both mechanical and hand-thinning units adjacent to sensitive travel corridors, typically resulting in stumps 6 inches or less in height within 300 feet of the travel corridor.
- Tree marking: During tree marking, open and enhance views of residual old growth trees near the sensitive travel routes and use areas, where possible.
- Target consumption of burn piles to 70 percent or greater.

#### 1.6.1.24 Heritage

- Prescribed burning: During prescribed burning, a 50-foot protective "black line" would be placed around fire-sensitive historical properties. A black line is created by burning the organic matter and then extinguishing the fire. Heavy fuels would be removed from the site by hand. No staging of equipment within site boundaries would occur. No slash piles within site boundaries would occur. No ignition points within the fire-sensitive site boundaries would occur.
- Thinning, hand treatments: During thinning treatments (by hand), a 50-foot protective buffer or boundary would be placed around historical properties. Hand treatments inside the boundary would be conducted to reduce heavy fuel loading and reduce overall fire effects. No staging of equipment or vehicles would be permitted. No slash piles would be constructed within site boundaries. There would be no dragging of logs, trees, or thinned material across or within site boundaries.
- Thinning, mechanical treatments: During thinning, hand and mechanical treatments, a 50-foot protective buffer or boundary would be placed around historical properties. Mechanical treatments or ground disturbance, use of vehicles or other mechanized equipment, and staging of equipment would not be permitted within site boundaries. Also, slash pile construction and dragging of logs, trees, or thinned material across or within site boundaries would not be permitted.
- Discovery and education stipulation: All persons associated with operations under this authorization would be informed that any objects or sites of cultural, paleontological, or scientific value such as historical or prehistoric resources, graves or grave markers, human remains, ruins, cabins, rock art, fossils, or artifacts shall not be damaged, destroyed, removed, moved, or disturbed. In connection with operations under this authorization, if any of the above resources are encountered, the proponent would immediately suspend all activities in the immediate vicinity of the discovery that might further disturb such materials and notify the Carson National Forest authorized officer of the findings. The discovery must be protected until notified in writing to proceed by the authorized officer (36 CFR 800.110 and 112, 43 CFR 10.4).

#### 1.6.1.25 Range

- Historical range monitoring sites, including witness trees or posts, one-inch angle iron stakes, and any other site location markers, would be protected. These sites would not be used as locations for temporary access roads, skid trails, landing areas, or large slash piles.
- The sale administrator, pre-sale forester, small sales forester, or a combination would work closely with the district range staff to determine pasture use during harvest activities.
- Commercial skid trail layout would, in most instances, keep equipment on one side of the fence to avoid having to cut fences. Where fences need to be cut, the sale administrator would ensure fences are repaired after implementation in coordination with district range staff.
- Any range fences damaged during noncommercial fuelwood harvesting would be repaired.
- Temporary cattleguards may be installed on haul roads where gates exist within actively grazed pastures. All cattleguards on harvest haul roads would be maintained throughout hauling activities.
- Range and fire managers would coordinate grazing schedules and prescribed fires on allotments within burn units to ensure there is sufficient surface fuel to allow burn objectives to be met. If grazing cannot cease long enough for sufficient fuel to build up to meet objectives, planned prescribed fires would be postponed until there can be sufficient fuel to meet objectives.
- Gates would be closed during implementation to ensure livestock are in the appropriate pasture. Prescribed burns would be smaller and could require coordination with the permittees and would typically be done prior to cattle coming into pastures or after they are moved off the pasture.
- Thinning operations would need to maintain the fences along the areas where implementation would occur. There is enough flexibility in the pasture rotations that rest prior to prescribed fire should not be needed.

## 1.6.2 Project Design Features Specific to Alternative 1

### 1.6.2.1 Mexican Spotted Owl

Management guidelines from the 2012 Mexican spotted owl recovery plan would be followed, which include, but are not limited to:

Core areas

- Planned or unplanned fires should be allowed to enter core areas only if they are expected to burn at low intensity with low-severity effects.

Protected activity centers (activities located outside the core area)[6]

- Mechanical treatments would be conducted in up to 20 percent of the total non-core protected activity center area within each ecological management unit (treatments can exceed 20 percent of the non-core acreage within a single protected activity center).

[6] Mexican spotted owl protected activity centers do not currently exist within the project area. Should the need arise to establish a protected activity center during project implementation, this project design feature would apply.

All other areas containing habitat

- Treatments outside protected activity centers, but within Mexican spotted owl nesting and roosting habitats, would retain structural characteristics at or above levels described in Table 4.

**Table 4. Minimum desired conditions for mixed conifer forest areas managed for recovery nesting and roosting habitat**

| Ecological Management Unit Forest Type | Percent of area[1] | Percent BA by size class 12-18 inch dbh (30-46 cm) | Percent BA by size class Greater than 18 inch dbh (greater than 46 cm) | Minimum tree BA[2] | Minimum density of large trees[3] |
|---|---|---|---|---|---|
| Mixed conifer (Southern Rocky Mountains) | 25 | >30 | >30 | 27.5 (120) | 30 (12) |

1 Percent of area pertains to the percent of the planning area, subregion, region, or a combination of these areas in the specified forest type that should be managed for threshold conditions.

2 Basal area (BA) in square meters per hectare (square feet per acre), and include all trees more than 1 inch in diameter at breast height (any species). We emphasize that values shown are minimums, not targets.

3 Trees more than 46 centimeters (18 inches) in in diameter at breast height (dbh). Density is trees per hectare (trees/ha). Again, values shown are minimums rather than targets. We encourage retention of large trees.

- Prescriptions for treatments outside protected activity centers but in forested stands identified as additional nesting and roosting habitat would be designed to attain conditions described in Table 4 as quickly as reasonably possible.
- Treatments within forested recovery habitat outside protected activity centers and outside stands managed for nesting and roosting habitat would be designed so most hardwoods, large snags (greater than 18 inches in diameter at breast height), large down logs (greater than 18 inches in diameter at any point), and large trees (greater than 18 inches in diameter at breast height) are retained, unless this conflicts with safety requirements, forest restoration, owl habitat enhancement goals, or a combination of these things. Treatments adequate to meet fuels and restoration management objectives in recovery habitats may result in the short-term loss of some habitat components in areas that could be occupied by spotted owls. Treatments outside protected activity centers, but within Mexican spotted owl restricted riparian areas, would be accomplished through consideration of abundance or deficient of key habitat components for the Mexican spotted owl (such as snags, large down logs, hardwood trees, or a combination of these things).

### 1.6.2.2 Northern Goshawk

- In general, guidelines for treatments are outlined in General Technical Report 310 (Reynolds et al. 2013). Some of these guidelines include, but are not limited to:
    - Northern goshawk post-fledging family areas should have 10 to 20 percent higher basal area in mid-aged to old tree groups than northern goshawk foraging areas and the surrounding forest. Goshawk nest areas should have forest conditions that are multi-aged and dominated by large trees with relatively denser canopies than the surrounding forest.
    - Lop and scatter thinning debris within post-fledging family areas and avoid piling debris.

- Design of appropriate treatments outside goshawk post-fledging family areas would be based on existing cover type and size of stand. Prescriptions would consider desired conditions, including stand composition, structure, and distribution, based on the cover type available both within the treatment unit and across the project area. Desired conditions include:
    - Within ponderosa pine and dry mixed conifer stands, manage over time for uneven-aged stand conditions composed of heterogeneous mosaics of tree groups and single trees, with interspaces between tree groups. The size of tree groups, as well as sizes and shapes of interspaces should be variable. Over time, the spatial location of the tree groups and interspaces may shift within the uneven-aged stand.
    - Tree group spatial distribution in the treatment area may be highly variable based on the local site and current conditions; the interspaces between groups should range from 20 to 200 feet but generally between 25 and 100 feet from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.
    - At the landscape scale and mid-scale, the number of trees per group and number of groups per area should vary across the landscape. Collectively these stands should aggregate to uneven-aged forest landscapes, similar to natural conditions.
    - In ponderosa pine and dry mixed conifer, snags and coarse woody debris should be well distributed throughout the landscape. Snags are typically 18 inches in diameter or greater and average 3 per acre. Coarse woody debris, including logs, may range from 5 to 15 tons per acre. Logs may average 3 per acre within the forested area of the landscape.

#### 1.6.2.3 Watershed

*Steep Slope Ground-Based Treatments (40 to 75 percent slope) Practices:*

- Cut-to-length treatment systems would be utilized only using specified equipment, such as a harvester/forwarder combination. Equipment would be operated on a slash mat created by limbs and tops of processed trees.
- Skid trails and routes would be designated through consultation with a Forest Service watershed specialist.
- Slash mats should be used to prevent rutting and erosion, where possible. Slash mats need to be sufficient to prevent tire or track ruts greater than 4 inches in depth. If excessive rutting or compaction does occur, additional slash mat depth may be required.
- Slash mats would be retained on site, unless there are fuels concerns in specific areas or the soils are determined to be recovered.
- No ground-based equipment would be used on slopes above 75 percent.
- Operations would only occur when soils are dry. Soils are considered dry when soil moistures are below their plastic limit. Observations of the extent of rutting can be used as a surrogate for interpreting soil moisture amounts. Where greater-than-4-inch ruts are observed during operation of heavy equipment, generally soils may be too moist for ground-based equipment operation. Additional best management practices may be required, such as addition of more slash on routes or avoidance of wet areas.

- The appropriate time of year for harvesting would be determined based on the sensitivity of the soils as defined below.
    - Forty to 75 percent slopes: Timber on all soils at this slope range would only be harvested when dry and during the driest part of the year. Operations would be carried out in early summer or fall and would not take place during the monsoon season.
    - Winter logging would occur only under the following conditions: Soil is frozen to a depth of 6 inches; soil is armored with a minimum of 8 inches of packed snow; or soil is armored with a minimum of 16 inches unpacked snow. Be prepared to suspend operations if conditions change rapidly and likelihood of soil damage from displacement or rutting becomes high.
    - Prescribed fire planning measures on slopes 40 percent and greater would take steps to mitigate soil impacts and minimize accelerated erosion. Examples may include evaluating different ignition strategies, minimizing burn severity, creating larger unburned mosaics, back burning, and ensuring full consumption of ground cover does not occur.

## 1.6.3 Project Design Features Specific to Alternative 2

### 1.6.3.1 Mexican Spotted Owl

Management guidelines from the 1995 Mexican spotted owl recovery plan would be followed, which include, but are not limited to:

Activity center area

- No treatments would occur within the 100-acre activity center within a protected activity center.
- Within protected activity centers[7]
    - Fuelwood harvesting and fire-risk-abatement treatments would be utilized within protected activity centers (outside the no-treatment activity center area) using a combination of thinning trees less than 9 inches in diameter, mechanical fuel treatment, and prescribed fire.
    - Commercial timber harvest would be prohibited within established protected activity centers.

All other areas containing habitat

- Treatments outside protected activity centers, but within Mexican spotted owl protected areas, would retain conifers greater than 9 inches in diameter at breast height, hardwood trees greater than 10 inches in diameter at the root collar, snags, large woody debris, and down logs. Prescriptions would utilize actual conditions as opposed to modeled habitat.
- Treatments outside protected activity centers, but within Mexican spotted owl restricted areas, would retain all trees greater than 24 inches in diameter at breast height, snags 18 inches in diameter, down logs over 12 inches in diameter, and large hardwoods. Prescriptions would utilize actual conditions as opposed to modeled habitat.

[7] Mexican spotted owl protected activity centers do not currently exist within the project area. Should the need arise to establish a protected activity center during project implementation, this project design feature would apply.

- Treatments outside protected activity centers, but within Mexican spotted owl restricted riparian areas, would be accomplished through consideration of abundance or deficient of key habitat components for the Mexican spotted owl (such as snags, large down logs, hardwood trees, or a combination of these things).
- At least 170 basal area would be retained in stands designated as restricted habitat, totaling 390 acres, located outside proposed fuelbreak units to meet 10 percent requirement for restricted habitats at 170 basal area:
- At least 150 basal area would be retained in stands designated as restricted habitat, totaling 560 acres, outside proposed fuelbreak units to meet 15 percent requirement for restricted habitat at 150 basal area:

#### 1.6.3.2 Northern Goshawk

In general, guidelines for treatments are outlined in the current forest plan and include, but are not limited to:

- Post-fledging family areas would consist of a minimum of 180 acres of nest areas, which consist of both active and alternative nest sites.
- Within an active post-fledging family area, high-intensity crown fires would be avoided year-round, and the entire home range of the goshawk would not be prescribed-burned within a single year.
- Within nesting areas, outside of the breeding season, a non-uniform, thin-from-below approach would be utilized, using hand tools and prescribed fire, to reduce fuel loads. Lopping and scattering of thinning debris is preferred if prescribed fire cannot be used. Piling of debris would be limited.
    - Treatments should not reduce canopy cover below minimum thresholds within goshawk foraging areas or within post-fledging family areas.
    - For the ponderosa pine cover type outside post-fledging family areas, canopy cover for mid-aged forest (vegetation structural stage 4) should average greater than 40 percent; mature forest (vegetation structural stage 5) should average greater than 50 percent; and old forest (vegetation structural stage 6) should average greater than 60 percent.
    - For the ponderosa pine cover type within post-fledging family areas, canopy cover for one-third of mid-aged forest (vegetation structural stage 4) should average greater than 60 percent; canopy cover for two-thirds of mid-aged forest (vegetation structural stage 4) should average greater than 50 percent; and mature (vegetation structural stage 5) and old forest (vegetation structural stage 6) should average greater than 50 percent.
    - For the mixed conifer cover type within post-fledging family areas, canopy cover for mid-aged (vegetation structural stage 4) to old forest (vegetation structural stage 6) should average 60 percent.
- In appropriate stands, openings would be established generally ranging from 1/10 to 1/4 of an acre in size within northern goshawk post-fledging family areas and not to exceed four acres with a maximum width of 200 feet outside post-fledging family areas.
    - One group of reserve trees of 3 to 5 trees per group would be retained per acre for openings greater than one acre in size.

- Within the ponderosa pine cover type, retain two snags per acre, three down logs per acre, and 5 to 7 tons of woody debris per acre.
- Within the mixed conifer cover type, retain three snags per acre, five down logs per acre, and 10 to 15 tons of woody debris per acre.

#### 1.6.3.3 New Road Construction

- Consult Carson National Forest terrestrial ecosystem survey for potentially unsuitable soils and terrain.
- Locate roads to fit the terrain, follow natural contours, and avoid steep grades.
- Once the new road alignment has been field-surveyed and flagged, verify alignment for potential areas of concern (seeps, springs, meadows, riparian-wetland areas, stream crossings) with watershed specialist. Design the road surface drainage system to intercept, collect, and remove water from the road surface and surrounding slopes in a manner that reduces concentrated flow in ditches, culverts, over-fill slopes, and road surfaces.
- Design the road for minimal disruption of natural drainage patterns and to reduce the hydrologic connection of the road segment or network with nearby waterbodies.
- Avoid sensitive areas such as riparian areas, wetlands, meadows, bogs, and fens, to the extent practicable.
- Provide sufficient buffer distance at the outfalls of road surface drainage structures for water to infiltrate prior to reaching a stream and limit the number and length of water-crossing connected areas to the extent practicable.
- Schedule construction activities to avoid direct soil and water disturbance during periods of the year when heavy precipitation and runoff are likely to occur.
- Install and maintain erosion and stormwater controls as necessary to ensure proper and effective functioning (sediment filters, straw bales, and wattles).
- Design and minimize stream crossings to avoid or minimize adverse effects to soil, water quality, and riparian resources.
- Reference USDA Forest Service (2011) for further direction on best management practices for new road construction.

## 1.7 Monitoring

- Monitoring could determine if illegal off-highway vehicle use is taking place in areas where treatments have occurred or along closed or obliterated roads. If monitoring reveals this is happening, steps could be taken to prohibit the use (signing, barrier installation, increased law enforcement).
- Best management practices application and effectiveness would be monitored.

# 2. Environmental Impacts of the Action Alternatives

This section includes information from each resource report located in the project record. The reports contain detailed data, methodologies, analyses, conclusions, assumptions, maps, references, and technical documentation. Each resource section below discloses potential direct, indirect, and cumulative effects of the alternatives. The list of past, present, and reasonably foreseeable future activities considered in the cumulative effects analyses are in appendix B (appendices are in a separate document).

## 2.1 Silviculture and Forestry

### 2.1.1 Topics and Issues Addressed in This Analysis

In its current state of uncharacteristic tree density, general forest health is at risk from insects, such as western pine beetle (*Dendroctonus brevicomis*), Douglas fir beetle (*Dendroctonus psuedotsuga*), and spruce budworm (*Choristoneura freemani*), and from stand-replacing wildfires. There is a need to reduce stand densities to lessen the risk from these biotic and abiotic agents of disturbance. Analysis of the reduction of stand density is discussed below.

Resource indicators are used to measure the effectiveness of actions taken to meet the purpose and need for a project. In this case, there is a need to reduce the density of forested stands in the project area as well as to reduce the amount of shade-tolerant species (for example, shade-tolerant firs) across the project area. The need for this is to propel the existing forested structure and composition closer to the historic range of variability of a given forest type.

Relative density is the resource indicator to measure stand density across the project area and to determine treatment effectiveness. Species dominance will be the resource indicator to measure treatment effectiveness in reducing the amount of shade-tolerant species across the project area. Table 7 describes these indicators and measures. Relative density is a measure of the amount of tree vegetation on a unit of land area. Relative density measures how full a stand is, or how much growth potential individual trees in a stand have, based on limiting factors such as the number, size, and species of the rest of the trees in that stand.

When the relative density of a stand is calculated between 0 to 25 percent, the stand is considered understocked; the same is true for stands. When a stand's relative density is calculated to have reached 25 percent relative density, it is considered at full site occupancy; again, the same is true of stands. Trees in stands with relative densities of 25 to 55 percent are assumed to be intercompeting but not experiencing competition-based mortality. Stands between 25 to 55 percent are growing at maximum volume production. Stands with relative densities greater than 55 percent are assumed to be experiencing competition-based mortality. When the average stand's relative density exceeds 55 percent, the stand has crossed the "threshold of imminent mortality" (Oliver and Uzoh 1995). These high relative density stands have individual trees that are weakened because they are competing with their neighbors for limited resources such as light, water, and nutrients. Individual trees in this weakened state, which can be exacerbated by drought, are considerably more susceptible to agents of disturbance like insects and disease. Species dominance refers to the species that predominates in an ecological community; in this case, tree species in a forested community, particularly when they are the most numerous or form the bulk of the biomass.

## 2.1.2 Affected Environment

### 2.1.2.1 Existing Condition

Current forest vegetation conditions are the result of various natural and human activities that have changed the historical condition of the forests and shaped the existing forest structure and composition. Timber harvest over the past century and a half has removed many of the larger shade-intolerant[8] species. This selective timber harvest, combined with the suppression of fire, has increased the amount of shade-tolerant species across the project area. As a consequence of this changed condition from the historical, forests are experiencing lowered resistance and resilience with respect to disturbance agents.

#### *Existing Forest Types*

Forest type is expressed by the existing dominant species in a stand as measured by its basal area in the stands. Existing forest types in the project area and their percentage of the project area are displayed in Table 5 Table 5. Forest cover types within the Pueblo Ridge Project analysis areaand discussed below.

**Table 5. Forest cover types within the Pueblo Ridge Project analysis area**

| Forest Cover Type | Area (acres) | Existing Relative Density (%) | Proportion of Analysis Area (%) |
|---|---|---|---|
| Mixed conifer[9] | 3,855 | 67.1 | 44.1 |
| Ponderosa pine | 2,776 | 70.6 | 24.8 |
| Piñon/juniper | 2,368 | 82.1 | 24.3 |
| Aspen | 476 | 65.1 | 4.9 |
| Engelmann spruce-subalpine fir | 51 | 71.5 | 0.6 |
| Gambel oak | 183 | 45.1 | 1.8 |
| Totals or percentages | 9,709 | 70.8 | 100 |

**Mixed Conifer**

Mixed conifer is the most common forest type, making up approximately 44 percent (3,855 acres) of the project area. The mixed conifer cover type is comprised mainly of white fir and Douglas fir with a mixture of other species depending on elevation and aspect throughout the analysis area. Mixed conifer occupies elevations ranging from 7,700 to 9,700 feet. Ponderosa pine is a seral species and may be found in the overstory and understory at the drier, lower elevations on southerly and southeasterly facing slopes. Blue spruce *(Picea pungens*), Engelmann spruce, and corkbark fir may be found at wetter and higher elevations on north-facing slopes. Quaking aspen clones can be found throughout all elevations with varying composition and structure.

[8] Shade-intolerant species need direct or almost direct sunlight and do not regenerate in a stand that has heavy canopy cover. Existing shade-intolerant individuals in the understory are either suppressed or killed. These species include ponderosa pine, aspen, and to some extent Douglas fir.

[9] Mixed conifer encompasses the Douglas fir and white fir types.

Intensive stand exam data was collected for the mixed conifer acres for the Pueblo Ridge Restoration Project analysis area. Simulations were performed with the FSVeg spatial data analyzer program, It uses forest vegetation simulator as the internal program to model the stand dynamics of the existing condition and proposed action. Existing average relative density for the mixed conifer forest type was estimated at 67.1 percent. When relative density in a stand exceeds 65 percent, individual trees begin to experience density-related mortality due to a lack of resources (Oliver and Uzoh 1997). In addition to density-related mortality, these stands can also be considered at high risk from insects, disease, and wildfire because of stress.

**Ponderosa Pine**

Ponderosa pine *(Pinus ponderosa)* is the second most common forest type, making up approximately 25 percent (2,776 acres) of the project area. The ponderosa pine cover type occupies elevations ranging from 7,000 to 9,500 ft. Ponderosa pine is a climax species at lower elevations where it generally grows with piñon pine and Rocky Mountain juniper. At higher elevations, ponderosa pine is often seral and is replaced through time by shade-tolerant conifers through forest succession. Stand composition varies throughout the analysis area with some stands comprised of scattered ponderosa pines (legacy trees) with small sawtimber and pole-sized trees.

Other stands consist of ponderosa pines with sapling and pole-sized trees where fire suppression has been in effect and there has been limited treatment activity. Piñon pine are present in the understory of most stands at lower elevations, and shade-tolerant species such as white fir are present at higher elevations, with minimal to no regeneration of ponderosa pine due to a high density of sapling and pole-sized trees.

Ponderosa pine stands received intensive stand exams. Existing average relative density for the ponderosa pine forest type was estimated at 70.6 percent. In this existing condition, the average ponderosa pine stand in the project area is at risk from agents of disturbance, such as insects, disease, wildfire, and a changing climate.

**Piñon/Juniper**

Piñon/juniper is the third most common cover type within the project area and makes up approximately 24 percent (2,368 acres) of the project area. The piñon/juniper cover type occupies elevations ranging from 7,000 to 8,400 feet. The most common species in this forest cover type include two-needle piñon pine *(Pinus edulis)*, Rocky Mountain juniper *(Juniperus scopulorum),* and one-seed juniper *(Juniperus monosperma)*. The understory primarily consists of Gambel oak *(Quercus gambelii)*, mountain mahogany (*Cercocarpus montanus*), and big sagebrush *(Artemisia tridentate)* at varying degrees with little grass and forb cover. Regeneration primarily consists of piñon pine and juniper seedlings and saplings. Most stands have an uneven-aged structure with three distinct size classes.

Like the mixed conifer and ponderosa pine areas, piñon/juniper stands received intensive stand exams. Existing average relative density for the piñon/juniper forest type was estimated at 82.1 percent. In terms of densification, piñon/juniper stands are the most “crowded” stands in the project area. In this existing condition, the average piñon/juniper stand in the project area is at risk from agents of disturbance, such as insects, disease, wildfire, and a changing climate.

### Aspen

Aspen *(Populus tremuloides)* is the fourth most common cover type and makes up approximately 5 percent (476 acres) of the project area. Aspen occupies elevations ranging from 8,300 to 9,600 feet within the project area. Aspen is a disturbance-driven species that relies on natural or human-caused disturbance for regeneration. Because of aggressive fire suppression and limited treatments over the last century, aspen composition within the analysis area and in the Carson National Forest has diminished. Aspen is a keystone species with positive impacts for species such as Rocky Mountain elk. Some stands are exclusively dominated by the aspen cover type with fir encroachment, while other stands have not experienced any forms of natural or human-caused disturbance. This has created stand conditions dominated by shade-tolerant conifer with some aspen inclusions or pockets in the overstory.

### Spruce/fir

One 51-acre Engelmann spruce/subalpine fir stand (less than 1 percent of the project area) is located within the project area. Spruce/fir occupies elevations from 8,600 to 10,300 feet. Historic conditions for the spruce/fir cover type likely resemble existing conditions, characterized by a high-severity fire regime that could have resulted in stand replacement for 66 to 100 percent of an area burned (USDA Forest Service 2012). This fire regime would promote even-aged, closed-canopy stands with vertical continuity of live fuels between the understory and forest canopy due to less frequent fire and an abundance of shade-tolerant species regenerating in the understory.

Spruce/fir forest types received intensive stand exams. Existing average relative density for this forest type was estimated at 71.5 percent. In this existing condition, the spruce/fir stand in the project area is considered within the zone of imminent mortality and at risk from agents of disturbance in its existing condition.

### Gambel Oak

Gambel oak is found throughout the project area and makes up 2 percent (183 acres) of the total acreage. Gambel oak occupies elevations ranging from 7,100 to 8,400 feet. Gambel oak is found in pure stands with scattered, larger trees consisting of ponderosa pine and piñon/juniper. Gambel oak is also a major component of the understory in conifer stands that are primarily comprised of ponderosa pine, but it can also be found in stands containing Douglas fir and white fir.

Gambel oak forest types received intensive stand exams. Existing average relative density for this forest type was estimated at 45.1 percent. In this existing condition, the average Gambel oak stand in the project area is still considered to have healthy growth potential and is only slightly at risk from agents of disturbance, such as insects, disease, wildfire, and a changing climate.

There has also been considerable deviation from the historical stand structure. Stand structure is increasingly homogenous. Openings once dominated by grasses and forbs have been encroached and overtopped with conifers. Stands that were less dense and dominated by large-diameter trees now have smaller-diameter trees with interlocking crowns, with small diameter, shade-tolerant species creating fuel ladders from the forest floor into the canopies of the dominant trees. Many stands in the project area are undergoing species conversion from shade-intolerant species to shade-tolerant species. The shade-intolerant species trees tend to be the older and larger, dominant trees in most stands. These large trees are being outcompeted by younger shade-tolerant tree species, and the shade-intolerant, larger trees are not able to reproduce. Stands of aspen are being encroached and overtopped by conifers, and they are slowly being removed from the landscape. In many areas, riparian vegetation is being encroached and overtopped by conifers.

In the forested portions of the project area, vegetation resource conditions have changed, primarily due to fire exclusion. Specifically, there are more trees (densification) and understory vegetation (shrubs, brush, and small-diameter trees) than what historically occurred under a frequent, low-intensity fire regime.

Existing stand densities are considerably higher than historical levels when measured by relative density. Stand structure is also altered with an increase in the number of multi-layered canopy stands and altered species composition due to fire exclusion. When combined with drought, these elevated stand densities, altered structure, and species composition can make the existing stands very susceptible to biotic disturbance agents like bark beetles, spruce budworm, root diseases, and dwarf mistletoes.[10] Walkthroughs of project area stands and stand exam data show native insects, such as bark beetles[11] and defoliators,[12] are present at normal levels. Although insects are at normal levels, the project area is susceptible to insect outbreaks due to existing stand structure. Additionally, these same observations indicate the presence of root diseases such as Armillaria[13] *(Armillaria ostoyae)* and Annosus[14] *(Heterobasidion annosum*). Root diseases are more virulent in higher-density stands (USDA Forest Service 2005). In their current state, project area stand density, structure, and species composition are susceptible to outbreaks of these native insects, root diseases, and dwarf mistletoes if densities, structures, and compositions are not altered to a less susceptible state.

Riparian areas are experiencing encroachment by conifers. This puts the integrity of the riparian areas at risk from wildfire, as a result of their overstocked condition.

Old growth is defined as containing a number and minimum size of both seral and climax dominant trees that are multi aged, with multi-layered canopies, a minimum number and specific size of snags, and an adequate number of down logs and coarse woody debris (Helms 1998). The 1996 forest plan amendment provides guidelines relevant to old growth, and these guidelines have been followed during the planning phase of this project. Characteristics of old growth specified by the 1996 forest plan amendment include number, age, size, and length of down logs and the number of tree canopies. Appendix A identifies minimum structural attributes that must be considered to determine old growth on the Carson National Forest. The 1996 forest plan amendment states no less than 20 percent of each forested ecosystem management area should be allocated to old growth.

Stand exam data collected across 98 percent of the project area was used to identify stands with old-growth characteristics. Analysis of stand exam data suggests approximately 23.3 percent of the project area (2,284 acres) meets or exceeds minimum old-growth thresholds. Figure 7 displays stands identified as old growth within the project area. The forest plan states there should be retention or development of old-growth function in 20 percent of any given forest type.[15]

[10] Mistletoes were observed in ponderosa pine, white fir, and western juniper. Most observations were at the normal level, however there are pockets of heavy infestation of dwarf mistletoes spread across the project area.

[11] Western pine beetle, Douglas fir beetle

[12] Spruce budworm.

[13] Primary hosts are Douglas fir and white fir and to a lesser extent in ponderosa pine.

[14] The P strain of Annosus primarily affects ponderosa pine. The S strain affects true firs and Douglas fir to a lesser extent.

[15] Piñon/juniper, ponderosa pine, aspen, mixed conifer, and Engelmann spruce-subalpine fir.

Within the project area 43.7 percent of the piñon/juniper stands, 31.7 percent of the ponderosa pine stands, and 9.5 percent of the mixed conifer stands meet the requirement for old growth (Table 6). None of the aspen stands within the project area meet the requirements for old growth. Where we do not have old-growth conditions currently, management activities would be geared toward the development of future old-growth conditions on 20 percent of each forested cover type within the project area.

Table 6 illustrates the number of acres considered to be old growth by their forest type and total amount of old growth within the project area.

**Table 6. Old growth by forest cover types within the Pueblo Ridge Project analysis area**

| Forest Cover Type | Acres of Old Growth | Percentage of their Forest Types |
|---|---|---|
| Mixed conifer | 368 | 9.5 |
| Ponderosa pine | 880 | 31.7 |
| Piñon/juniper | 1,036 | 43.7 |
| Aspen | 0 | 0.0 |
| Engelmann spruce-subalpine fir | 0 | 0.0 |
| Old growth totals within project area | 2,284 | 23.3 |

Densification has been caused primarily by the suppression of wildfire and secondarily by selective logging in the twentieth century. The suppression of wildfire has prevented normal selective thinning of sapling and pole-sized trees in the forest understory, permitting continuous recruitment and increasing canopy cover by the shade-tolerant *s*pecies. With stand densification, there is an increase in canopy cover (Goforth and Minnich 2008) and trees per acre. The overabundance of sapling and pole-size trees which compete for limited soil moisture and nutrients is likely a factor causing decline of larger tree stem density.

Timber harvest over the past century and a half has removed many of the larger shade-intolerant[16] species. This selective timber harvest combined with the suppression of fire has increased the amount of shade-tolerant species[17] across the project area. The project area's forested stands are susceptible to insects, disease, and stand-replacing wildfires due to their current state of densification combined with species conversion and drought. Table 7 shows the existing condition of the resource indicators and measures.

The current relative density across the project area is at 70.8 percent (figure 8). At this elevated level, trees are competing with each other for finite resources such as water and nutrients. This competition weakens the trees to the point where they lack the resources to successfully defend against insects and disease. At this density level, tree canopies are not separated, smaller trees in the understory act as fuel ladder, and canopy base heights are low. All of these items create a significant risk to the existing stands from stand-replacing wildfire events.

[16] Shade-intolerant species need direct or almost direct sunlight and do not regenerate in a stand that has heavy canopy cover. Existing shade-intolerant individuals in the understory are either suppressed or killed. These species include ponderosa pine, aspen, and Douglas fir to some extent.

[17] Shade-tolerant species can survive in the shade of other trees. These species include white fir, Engelmann spruce, subalpine fir and to some extent Douglas fir.

The existing species dominance of shade-intolerant species is at 71.3 percent. The remaining 28.7 percent of the total basal area of trees in the project area is in shade-tolerant species. An objective of the project is to increase the percentage of species dominance of shade-intolerant species.

## 2.1.3 Environmental Consequences

### 2.1.3.1 Direct and Indirect Effects - Alternative 1

A direct effect of alternative 1 would be a reduction in live tree density in most size classes. This would increase growing space and availability of water, nutrients, and sunlight to residual trees. The number of shade-tolerant tree species, especially in the smaller-diameter classes, would be reduced. The number of smaller trees that are considered ladder fuels would be decreased. Canopy spacing and bulk densities would be reduced. Conifer densities would be reduced in aspen areas, which would promote greater aspen regeneration potential.

Indirectly, residual trees in treated areas would grow in an environment with reduced stress, resulting in decreased competition-related mortality. In addition, the treated areas would be more resistant to diseases and insects, especially bark beetles, due to increased tree vigor (Oliver and Uzoh 1997).

Alternative 1 would reduce the density of trees in the project area. Overall, relative density would be reduced from 70.8 percent to approximately 39.4 percent (see figure 9 and Table 7). This reduction in density takes the project area from a level where trees are dying from competition to a level where stands are still considered to be fully stocked and free to grow. Densities would remain higher in old growth, Mexican spotted owl areas, and goshawk areas but would still be lower than existing condition densities. Species dominance of shade-tolerant species would be increased by alternative 1. While not as dramatic a change as with density, shade-intolerant basal area would increase from approximately 71.3 percent to 79.0 percent if the proposed action is implemented.

Age and size class diversity of native deciduous trees and shrubs would be improved by removing non-native vegetation and encroaching conifers from riparian zones. Early-seral species distribution would increase and late-seral species densities would decrease following implementation, leading to improved habitat and riparian functioning condition with recruitment of hardwoods.

Treatments in the aspen forest type would reduce stand densities of encroaching shade-tolerant, late-seral conifers. Aspen regeneration would be triggered by implementing prescriptions tied to conifer removal and fuels treatment with prescribed fire. Wildlife habitat would be improved with the recruitment, establishment and maintenance of aspen populations while creating a patchy mosaic within the project area and disrupting aerial and surface fuel continuity.

### 2.1.3.2 Direct and Indirect Effects - Alternative 2

The direct and indirect effect of alternative 2 to relative density and species dominance are similar to the effects of alternative 1. Alternative 2 would improve forest conditions but not as effectively as alternative 1 (see Table 7).

Alternative 2 would reduce the density of trees in the project area. Relative density would be reduced from 70.8 percent to approximately 45.8 percent (see figure 10 and table 7). While alternative 2 would create a reduction in relative density, it drops the average relative density to somewhat less than the threshold where trees begin to die due to inter-tree competition. While not

as dramatic a change as in alternative 1, shade-intolerant basal area would increase from approximately 71.3 percent to 77.7 percent from alternative 2.

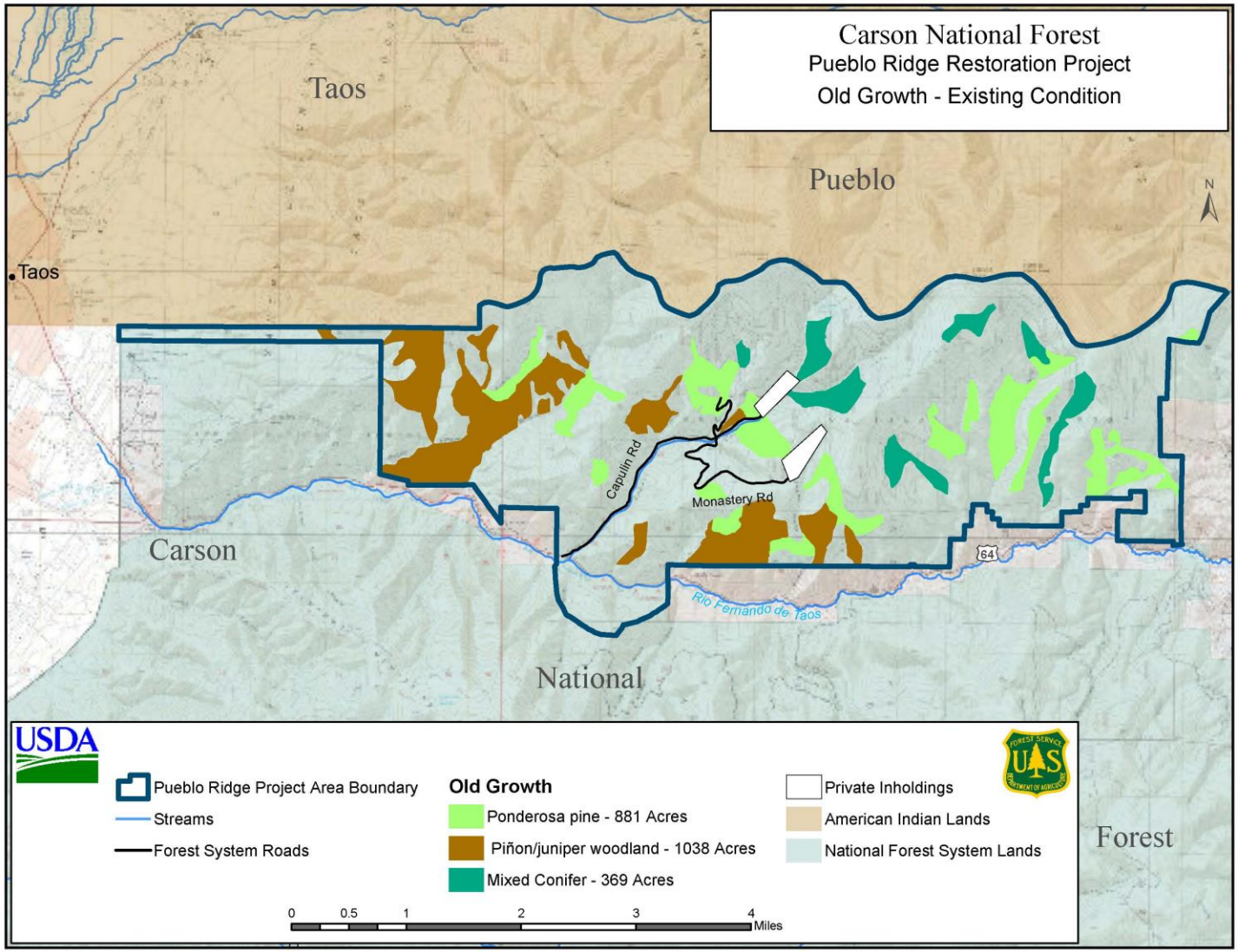


**Figure 7. Existing old growth stands 2017**

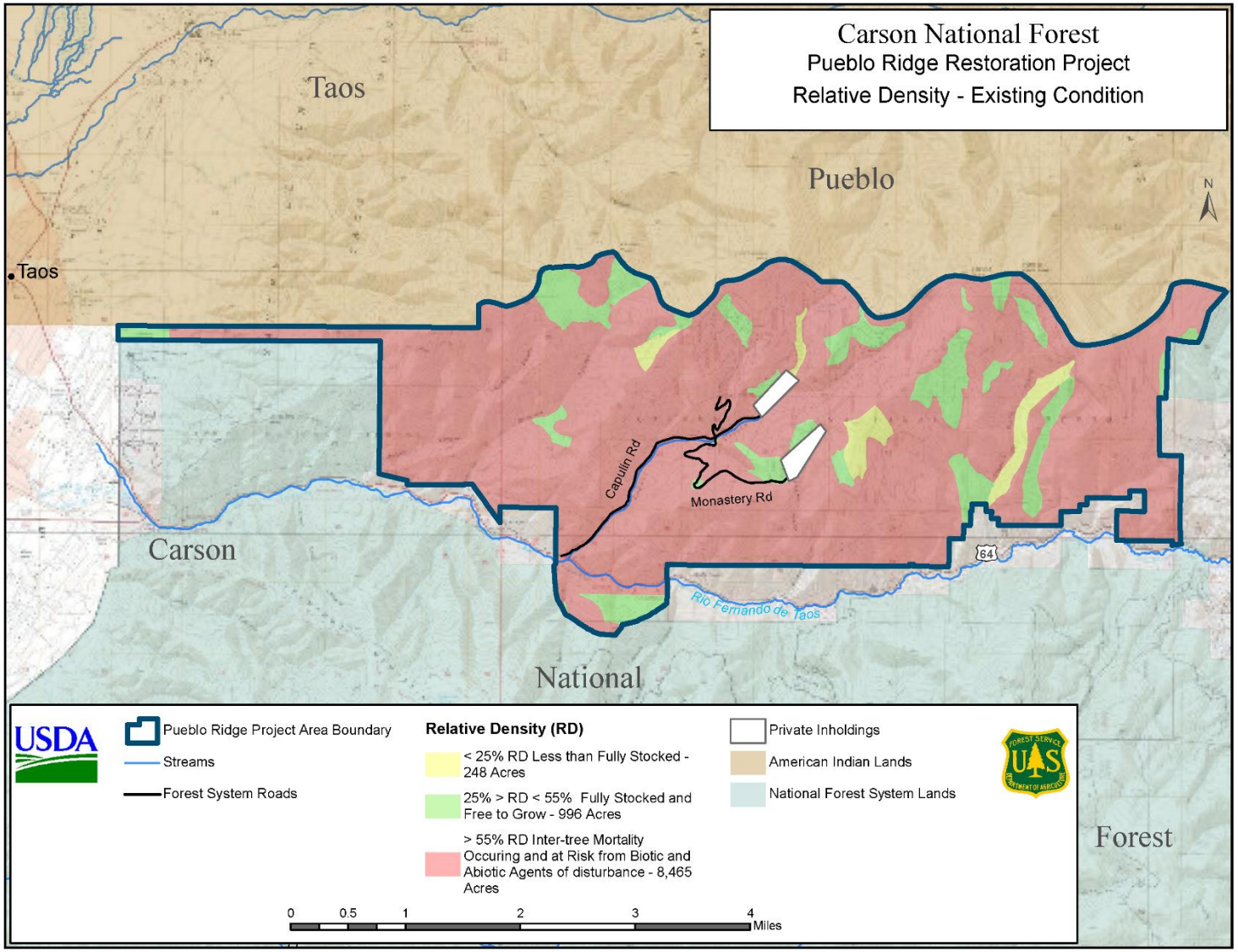


**Figure 8. Existing relative density**

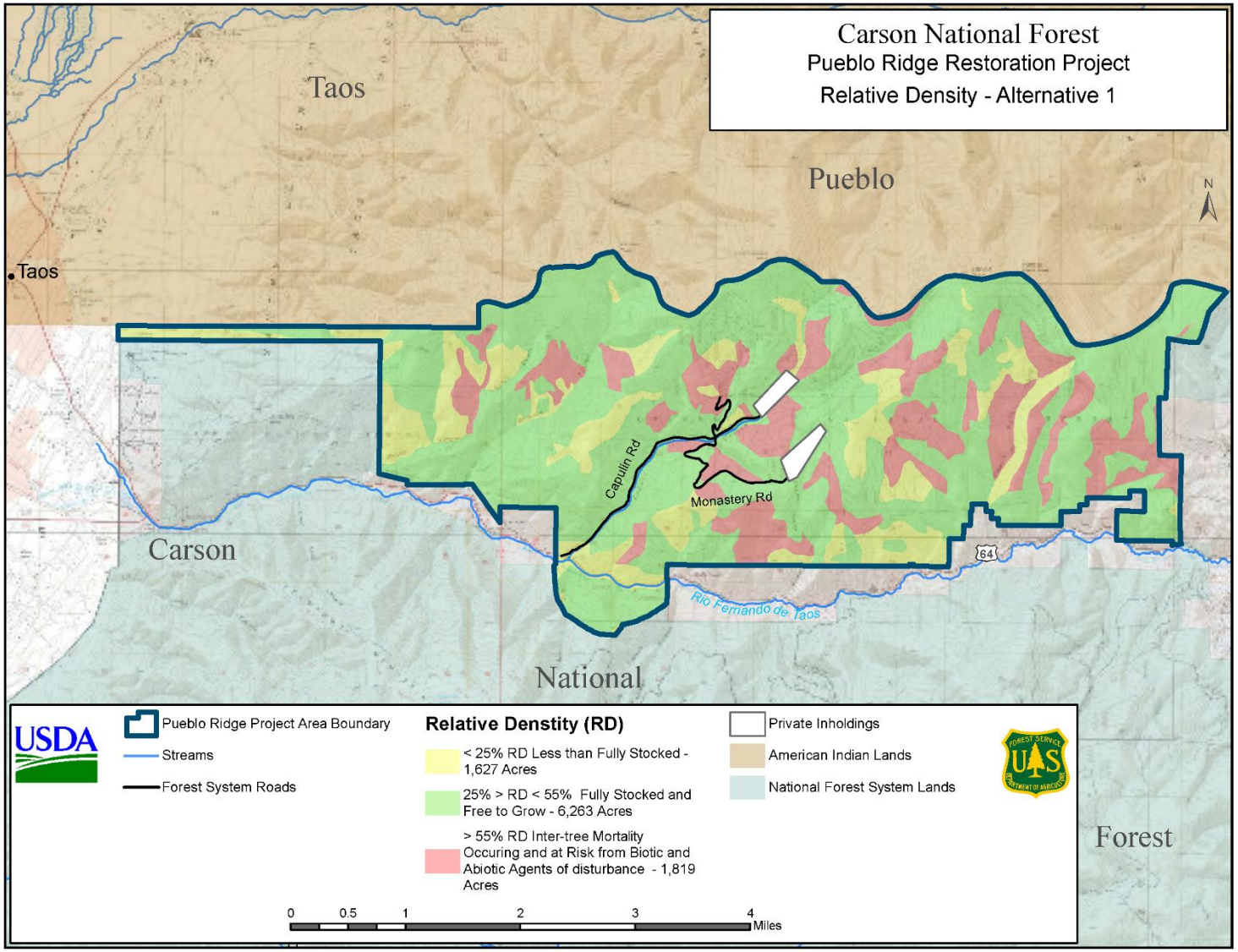


**Figure 9. Post-treatment residual density alternative 1**

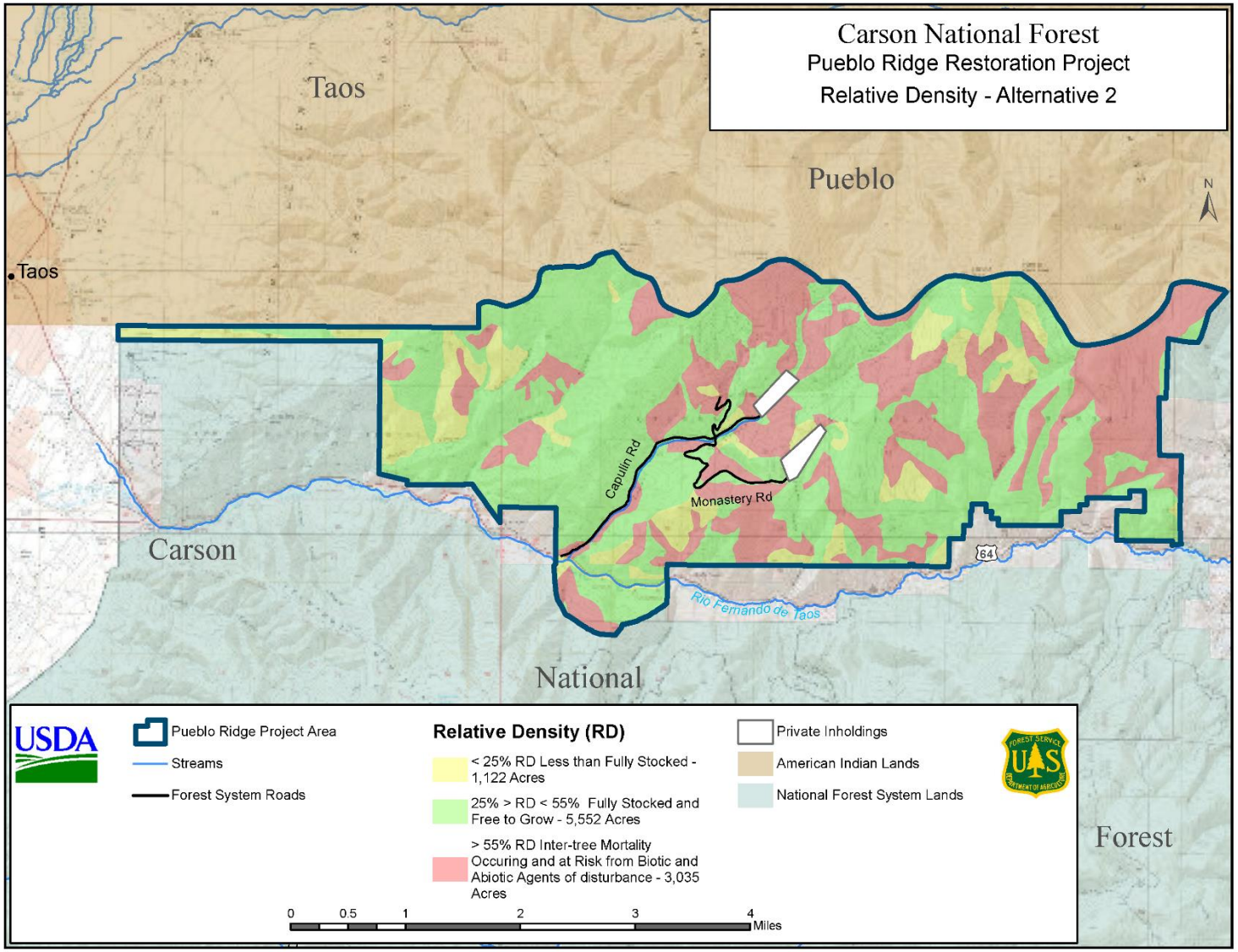


**Figure 10. Post-treatment residual density alternative 2**

### 2.1.3.3 Cumulative Effects – Alternatives 1 and 2

#### *Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis*

There are no cumulative effects to relative density or species dominance from this project with respect to other past, present, or reasonably foreseeable projects. As previously stated, the analysis area for cumulative effects is the project area itself. The existing condition of the forested areas within the project area is a result of past projects. The baseline year used for the existing condition in this analysis is 2017 when the stand exam data was collected.

## 2.2 Summary

As can be seen in Table 7, there is a difference in the reduction of relative density between the two alternatives. Alternative 1 would reduce the relative density of the project area 6.4 percent more than alternative 2. Both alternatives would meet the purpose and need of reducing stand densities from the current level where trees are at risk from agents of disturbance and are dying due to inter-tree competition.

There is a small difference between alternative 1 and alternative 2 with respect to halting and reducing the increasing dominance of shade-intolerant species across the project area. This could be due to different prescriptions affecting different acres in both alternatives, as well as prescribed burning early in the spring season. As can be seen in Table 7, alternative 1 is slightly more effective in reducing the amount of shade-intolerant species compared to alternative 2.

**Table 7. Existing condition and conditions resulting from alternatives for silviculture and forestry resources**

| Resource Element | Resource Indicator | Measure | Existing Condition | Conditions Resulting from Alternative 1 | Conditions Resulting from Alternative 2 |
|---|---|---|---|---|---|
| Densification | Overall project level relative density | Relative densities reduced from above 55 percent to within the acceptable range of 25 to 55 percent. | 70.8 percent | 39.4 percent | 45.8 percent |
| Landscape is trending from early to shade-tolerant species | Overall reduction the species dominance of late vs. shade-intolerant species | Basal area percentage of early versus shade-tolerant trees. An increase in the basal area percentage of shade-intolerant trees indicates fewer shade-tolerant trees. | 71.3 percent * | 79.0 percent ** | 77.7 percent |

* This represents the percentage of project area basal area in shade-intolerant species.

** This represents the percentage of project area basal area in shade-intolerant species.

The amount of acres considered to be both old growth and Mexican spotted owl habitat would not change from the existing condition following treatments. This is due to prescriptions[18] having thresholds that do not treat and remove forest structures below minimum thresholds for existing types of old growth and Mexican spotted owl habitat.

Alternative 1 would meet the project's purpose and need with respect to forest resiliency from biotic agents of disturbance better than alternative 2.

# 2.3 Fire and Fuels

## 2.3.1 Introduction

Fire has played an important ecological role in the history of the ecosystems of the Carson National Forest. Since the beginning of the early 20th century, the frequency of natural fire has decreased dramatically and has corresponded with an increased demand for wildland fire suppression to protect life and property. The reduction in fire frequency is, in part, a result of more than a century of intensive human activities, including fire suppression, livestock grazing, and logging.

## 2.3.2 Fire History and Occurrence

Fire was a common ecosystem process in Taos County before the policy of fire exclusion began early in the 20th century. Fire suppression and a lack of vegetation management have resulted in a high percentage of forest types on altered successional pathways from their historical composition, structure, and function. Accumulation of hazardous (natural and activity-created) fuel can increase the intensity and risk of unwanted wildland fire, causing damage to values within the wildland-urban interface or valuable ecosystem components.

In analyzing the risk, we first looked at the chance a fire might start. Wildfire history data from 1971 to 2017 indicated 22 fires have occurred within the Pueblo Ridge Restoration Project Area since 1971. Approximately 195 acres have burned, equivalent to approximately 2 percent of the project area, in 46 years. Other notable fires near the Pueblo Ridge Restoration Project are the Hondo fire in 1996 and the Encebado Fire in 2003 (figure 11). The Hondo fire occurred in the Sangre de Cristo Mountain Range north of the project area. It burned approximately 8,000 acres and 32 structures, and spread quickly due to fuel buildup in the forests and a particularly dry and windy season. This fire was especially important in bringing attention to the role climate change, altering precipitation patterns, and drought has on increasing the spread and severity of wildfires (Headwaters Economics 2016). The 2003 Encebado Fire burned 5,385 acres adjacent to the project area within Taos Pueblo lands, including the Blue Lake Wilderness Area. The Encebado Fire burned for nearly two weeks and required more than a thousand fire fighters to contain it. The post-wildfire effects of the Encebado Fire were particularly damaging to the larger Rio Pueblo watershed, thus highlighting the intimate linkages between watershed health and wildfire impacts (Headwaters Economics 2016).

[18] Treatment prescriptions based on diameter limits and residual trees per acre, basal areas, etc.

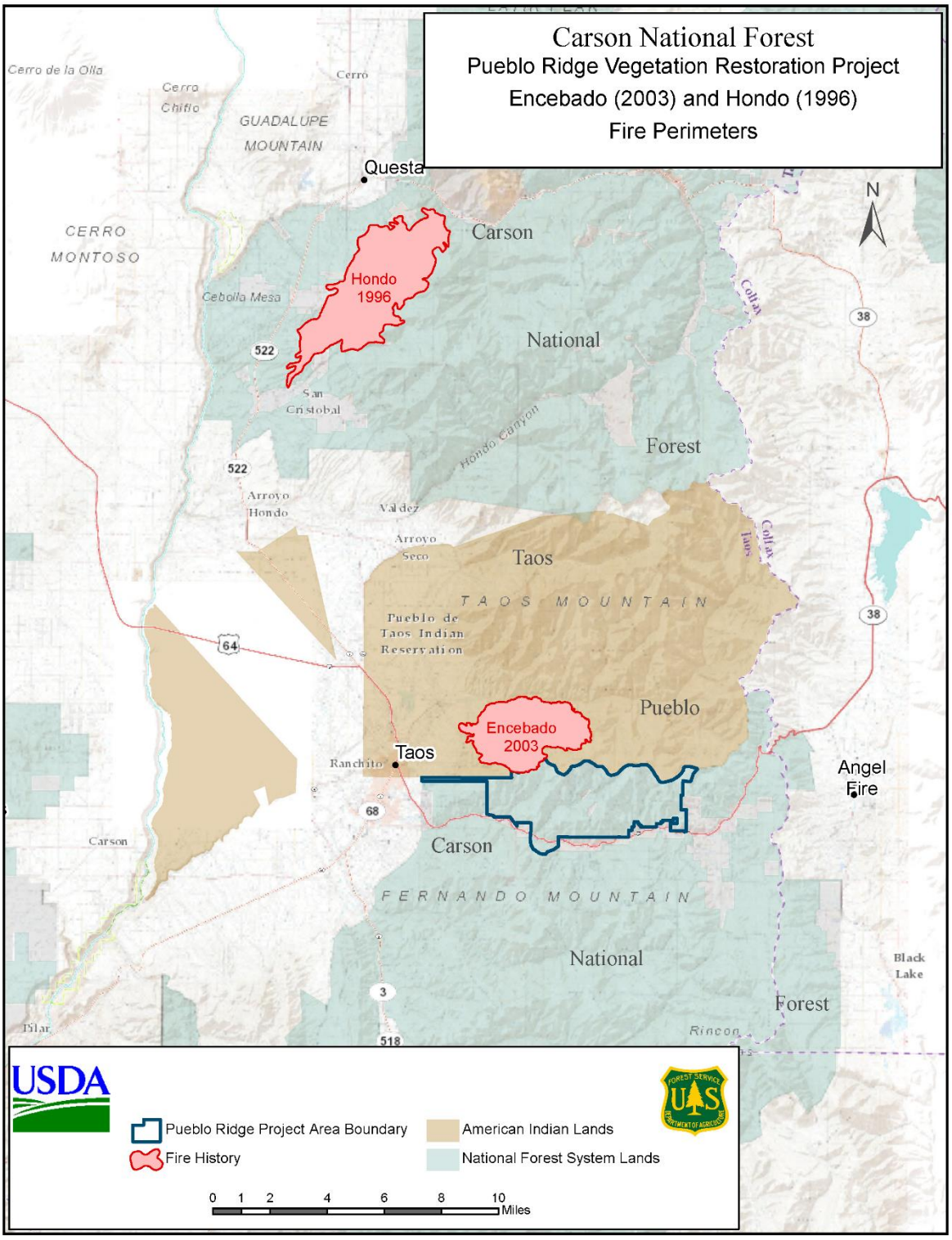


**Figure 11. Locations of the Hondo and Encebado Fires**

### 2.3.3 Managing Risk to the Wildland-Urban Interface

Wildfire is the primary natural disaster concern for Taos County and areas within and adjacent to the project area. Many homes and structures border the project area. In many cases, a hazardous fuel load that exists both on private and Federal lands borders the community. Often firefighting resources are faced with single-access ingress and egress through roads in narrow mountain canyons. Many homes in Taos County are in the timbered lands of the wildland-urban interface. Due to decades of fire exclusion, forest conditions progressively became overstocked and fuel loaded, creating a greater risk of crown fires in Taos County. The Hondo Fire and the Encebado Fire on Taos Pueblo manifested the risk of unhealthy forest conditions that had direct impact on communities in the wildland-urban interface. Both fires impacted and threatened Taos County communities.

As of 2013, approximately 67 square miles of land within the county was considered wildland-urban interface and contained more than 3,330 homes (16.4 percent of all homes in Taos County; 1,517 are second residences). More than 80 percent of the county's wildland-urban interface remains undeveloped. When considering homes within the wildland-urban interface most threatened by wildfire, Taos County ranks among the top counties in the West. In 2010, Taos County was in the 80$^{th}$ percentile when assessed for both existing and potential risk of wildfires compared to the other 11 western states. Within the state, Taos County is in the top 94$^{th}$ percentile for existing risk and 91$^{st}$ percentile for potential wildfire risk (Headwaters Economics 2016).

The Pueblo Ridge Restoration Project contains approximately 4,265 acres of designated wildland-urban interface within the project boundary. This equates to approximately 44 percent of the project area. Important infrastructure and values at risk within or adjacent to the project area include the heavily trafficked Highway 64 corridor in Taos Canyon, over 330 buildings, a rehabilitation clinic, campgrounds, recreational facilities, businesses, transmission lines, and the Taos Pueblo. Prevailing winds and dense forest vegetation within the project area and adjacent lands put the infrastructure at risk from wildfire. Dense fuels adjacent to urban developments, combined with limited access or egress, creates a complex environment for fire managers.

Research (Cohen and Butler 1998) has shown structures with typical ignition characteristics (wood sided, wood framed, asphalt composition roof) are at risk of catching on fire from one of three sources: direct flame contact to the structure, aerial transport of burning materials to a structure from vegetation or other burning sources, and exposure to intense flames from a nearby source. Cohen (2008) also asserts that during wildland-urban interface disasters, wildland fires are burning under conditions that are difficult to control, stating:

> The combination of vegetation, weather conditions, and topography produces fast-spreading, intensely burning fire behavior that overwhelms suppression efforts. If the extreme wildfire spreads close enough to residential development with its flames and firebrands (lofted burning embers), hundreds of ignitable homes can be simultaneously exposed. Although protection may be effective for some homes, an extreme wildfire's high intensities and high rate of area growth (rapid spread and spot ignitions) ignites too many houses and threatens firefighters' safety, preventing them from protecting all structures. With homeowners likely evacuated and firefighters unable to protect every house, initially small, easy-to-extinguish ignitions can result in total home destruction.

Treatments that allow access and egress for firefighters and the public can be a substantial advantage in a wildland-urban interface fire. The ability of local residents to evacuate along a route with reduced fire intensity and smoke is an advantage and is less likely to interfere or tie up emergency response resources with assisting or directing the public to areas outside the area impacted by fire. Increased access also allows rapid deployment of firefighting resources.

Firebrands from crown fires may be carried long distances, and fires that start from firebrands in or around homes can ignite structures. Treatments that center on high-value and strategic locations also make sense in managing fire spread across the landscape.

### 2.3.4 Fire Behavior

Fire behavior is the manner in which a fire reacts to available fuels, weather, and topography. A change in any of these components results in a change in fire behavior (DeBano et al. 1998). Fire behavior is complex, with three main contributing factors: topography (slope, aspect, elevation); weather (climate, air temperature, wind, relative humidity, atmospheric stability); and fuels (size, type, moisture content, total loading, and arrangement). These three elements comprise the fire environment, surrounding conditions, influences, and modifying forces that determine fire behavior.

Topography and weather at a given location are beyond the ability of management to control. The fuel portion of fire behavior is the only controllable factor and is therefore the one factor managers can use to manage fire hazard. Weather conditions, such as drought, high temperature, low humidity, and high wind, play a major role in the spread of wildfires and are influenced by topography and location of mountains, as well as global influences such as La Niña and El Niño. Weather conditions are a major factor in the initiation and spread of all wildfires, but Omi and Martinson (2002) found stands with prior fuel treatments experienced lower wildfire severity than untreated stands burning under the same weather and topographic conditions.

Fuels management modifies fire behavior, ameliorates fire effects, and reduces fire suppression costs and danger (DeBano et al. 1998). Manipulating fuels reduces fire intensity and severity, allowing firefighters and land managers more control of wildland fires by modifying fire behavior in the fire environment. Fuels management can include reducing the loading of available fuels, lowering fuel flammability, or isolating or breaking up large continuous bodies of fuels (DeBano et al. 1998). Fuels contribute to the rate of spread of a fire, intensity or flame length, fire residence time, and the size of the burned area (Rothermel 1983, Agee et al. 2000).

An effective fuels treatment treats the three components that can lead to high-intensity surface and crown fires in the project area: surface fuel loading, ladder fuels, and forest canopy bulk density. By lowering the surface fuel loading, the characteristics of fuels that lend themselves to the initiation of a crown fire can be changed to those with lower intensities. By removing or reducing ladder fuels (fuels that carry a surface fire into the tree crowns), conditions are created that would not allow a surface fire to move into the canopies. By reducing forest canopy bulk density, a timbered stand would be less capable of sustaining a high-intensity running crown fire, hence lowering the fire hazard in the project area.

## 2.3.5 Topics and Issues Addressed in This Analysis

### 2.3.5.1 Issues

Issues related to fire and fuels that will be addressed in the analysis are resilient forests and reducing hazardous fuels. The indicators used in this analysis will evaluate how well the alternatives would achieve the project's purpose relevant to fire and fuels management. They are as follows:

#### *Fire Hazard*

Two primary factors are involved when assessing the threat of wildland fire on a landscape: fire risk and fire hazard. Fire risk is the chance that a fire might start, as affected by the nature and incidence of causative agents (Hardy 2005). Fire hazard is a fuel complex, defined by volume, type, condition, arrangement, and location that determines the degree of ease of ignition and the resistance to control (Hardy 2005). This analysis will compare fuel models to determine the degree of ease of ignition, the resistance to control of fuels, and the potential for high-severity fire in the project area.

#### *Severity*[19]

The severity of a fire depends on the fire intensity and the degree to which ecosystem properties are fire resistant. An example of this would be a fire with the same fireline intensity might kill thin-barked trees but have little effect on thick-barked trees. Fire severity is, in part, a function of the ecosystem being burned and is not simply indexed from fireline intensity. If a fire has a long residence time, or duration of heating on the ground, fire severity will usually increase.

Other factors contributing to fire severity include residence time (heating duration), soil and plant dryness, pre-fire vegetation species composition, stand age, topography, and climate. These all have some effect on how fire intensity translates into fire severity. Fire severity is defined in Table 8 (Keeley 2009 and references therein).

**Table 8. Vegetation and soil impacts as related to categories of fire severity**

| Fire severity | Description |
|---|---|
| Unburned | Plant parts green and unaltered, no direct effect from heat |
| Scorched | Unburned but plants exhibit leaf loss from radiated heat |
| Light | Canopy trees with green needles although stems scorched. Surface litter, mosses, and herbs charred or consumed. Soil organic layer largely intact and charring limited to a few mm depth |
| Moderate or severe surface burn | Trees with some canopy cover killed, but needles not consumed. All understory plants charred or consumed. Fine dead twigs on soil surface consumed and logs charred. Pre-fire soil organic layer largely consumed. |
| Deep burning or crown fire: | Canopy trees killed and needles consumed. Surface litter of all sizes and soil organic layer largely consumed. White ash deposition and charred organic matter to several cm depth. |

[19] Fire severity is the effect of a fire on ecosystem properties, usually defined by the degree of soil heating or mortality of vegetation (Firewords.net).

### *Crown Fire Hazard*

Crown fire hazard is a physical situation of fuels, weather, and topography with potential for causing harm or damage as a result of crown fire. The potential crown fire activity can be reduced by manipulating canopy base height and canopy bulk density.

#### Canopy Base Height

Canopy base height, also known as height to base of live crown, indicates the average height above the ground above which there is sufficient canopy fuel to propagate fire vertically (Scott and Reinhardt 2007). Canopy base height is a property of a plot, stand, or group of trees not of an individual tree (crown base height). Low canopy base height (one element of ladder fuels) facilitates ignition of the crown fuels by a surface fire and then transition to some form of crown fire (passive or active). The higher the canopy base heights are from a surface fire, the less chance there is for a transition to a crown fire.

#### Canopy Bulk Density

Canopy bulk density describes the density of available canopy fuel in a stand. It is defined as the mass of available canopy fuel per canopy volume unit. Canopy bulk density is the primary controlling factor of crown fire behavior (Graham et al. 1999). It is used to predict whether an active (sustained not just torching as in passive crown fire) crown fire is possible. Jim Agee (1996) found crown fire wasn't sustained in stands where canopy bulk density was less than 0.100 kilograms per square meter. Therefore, canopy bulk density averaging less than 0.100 kilograms per square meter across the treatment area will be used as a measure.

#### Crown Fire Activity

Crown fire is the movement of fire through the crowns of trees or shrubs more or less independently of the surface fire. Model outputs are displayed as passive crown fire, active crown fire, or surface fire.

### *Surface Fire Hazard*

Fuels, weather, and topography combine to determine how hot and fast a fire burns. Surface fire hazard is the amount of available surface fuel[20] and the associated fire behavior exhibited as related to the fire's resistance to suppression.

#### Fuel Model

The different vegetation types in the project area were assigned fuel models that best represent the expected fire behavior in the project area. Fuel conditions are defined by quantity and arrangement and have been categorized into 13 standard descriptive fuel models (Andersen 1982). Fuel models are used as one of the inputs into fire behavior computer models to determine flame height and rate of spread for a wildfire. Fuel models are based on the surface (dead) fuels rather than live trees. Fires burn differently in the different fuel models under the same weather conditions.

[20] Loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches that have not yet decayed enough to lose their identity; also grasses, forbs, low and medium shrubs, tree seedlings, heavier branchwood, down logs, and stumps interspersed with or partially replacing the litter.

**Flame Length**

Flame length is an important measure of fire behavior as it is an observable characteristic of fire behavior that can be directly related to fireline intensity[21] (Agee 1996; Andrews and Rothermel 1982), which in turn influences crown fire initiation[22] (Agee 1996). Flame length is also important to fire managers as it can be used to determine resource (equipment) needs to suppress a wildfire. When fireline intensity is below 100 British thermal units[23] and flame lengths are less than 4 feet, suppressing fires can generally occur at the head[24] or flanks[25] of the fire by persons using hand tools. Handlines[26] should be adequate to hold the fire.

When fireline intensities are 100 to 500 British thermal units and flame lengths are between 4 and 8 feet, fires are too intense for direct attack at the head of the fire by persons using hand tools. Handline cannot be relied upon to hold the fire. Equipment such as bulldozers, engines, and retardant aircraft may still be effective. However, fire behavior is potentially dangerous to personnel and equipment.

When fireline intensities are 500 to 1,000 British thermal units and flame lengths are between 8 and 11 feet, fires will often present serious control problems, such as torching out, crowning, and spotting ahead. Control efforts at the head of the fire most likely will be ineffective, and indirect attack is the only means of suppression. Fire behavior is definitely dangerous for personnel and equipment.

Fires with fireline intensities above 1,000 British thermal units per foot of fireline per second generally have flame lengths that are greater than 11 feet. Crowning, spotting, and major fire runs are probable. Control efforts at the head of the fire are ineffective by any known means of suppression. Indirect attack and tactical burnout operations may be the only means to slow the spread of the fire in certain directions. These fires are extremely dangerous to personnel and equipment in the immediate vicinity of the fire.

These values have obvious implications for holding or suppression actions on wildfires. If only hand crews are available to hold firelines and handlines are the only lines of control, surface fires cannot exceed 100 British thermal units per foot per second nor can flame lengths exceed 4 feet to be effective in fire suppression (Andrews and Rothermel 1982). Direct suppression from hand crews is generally considered feasible when flame lengths are less than four feet and by equipment when flame lengths are less than eight feet.

Table 9 displays the relationship of flame length and fireline intensity related to fire suppression capabilities and potential fire behavior. These two variables can be visually identified and felt by fire resources on scene of a fire. As flame length, fireline intensity, or both increases, suppression capability, resource types, and tactics differ. Fireline intensities are measured in British thermal units per foot per second.

[21] The rate of energy or heat release per unit length of fire front, regardless of its depth (Byram 1959).

[22] Crown fire initiation and vertical spread occur when fire intensity attains a critical value that is a function of crown base height (VanWagner 1977).

[23] The amount of heat needed to raise one pound of water at maximum density through one degree Fahrenheit, equivalent to 1.055 multiplied by 103 joules.

[24] Head of the fire is usually the side toward which the wind is blowing and will also often be the upslope side of a fire. (nwcg.gov)

[25] The flanks of the fire are perpendicular to the head of the fire and usually describe the side of the fire (the right and left flanks) (nwcg.gov)

[26] A fire control line built with hand tools (shovels, Pulaskis)

**Table 9. Fire behavior interpretations**

| Flame Length (feet) | Fireline Intensity (BTU/Ft/Sec) | Interpretations |
|---|---|---|
| 0 to 4 | 0 to 100 | Persons using hand tools can generally attack fires at the head or flanks. **Handline should hold the fire.** |
| 4 to 8 | 100 to 500 | Fires are too intense for direct attack at the head of the fire by persons using hand tools. Handline cannot be relied on to hold fire. **Equipment such as dozers, engines, and retardant aircraft can be effective.** |
| 8 to 11 | 500 to 1,000 | Fires may present serious control problems such as torching, crowning, and spotting. **Control efforts at the head of the fire will probably be ineffective.** |
| More than 11 | More than 1,000 | Crowning, spotting, and major runs are common. **Control efforts at the head of the fire are ineffective.** |

BTU/Ft/Sec = British thermal units per feet per second

### Rate of Spread

Surface rate of spread reflects the forward rate of spread at the head of the fire. Rate of spread is directly influenced by effective wind speed (wind speeds at eye level) and the abundance and continuity of fine fuels (generally less than three inches in diameter).

**Table 10. Resource indicators and measures for fire and fuels resource**

| Fire and Fuels Resource Element | Resource Indicator | Measure |
|---|---|---|
| Fire risk | Severity | Percent of tree mortality |
| Crown fire hazard | Canopy base height | Feet from ground |
| Crown fire hazard | Canopy bulk density | Less than 0.0062 pounds per cubic feet is desired |
| Crown fire hazard | Crown fire activity | Surface fire, passive crown fire, active crown fire |
| Surface fire hazard | Fuel model | Fireline intensity (British thermal unit per foot per second). Average less than 100 |
| Surface fire hazard | Flame length | Less than 4 feet is desired |
| Surface fire hazard | Rate of spread | Average less than 18 chains per hour |

## 2.3.6 Affected Environment

### 2.3.6.1 Existing Condition

The current condition is best understood when it is compared with the historic range of variability so as to provide perspective of change. Vegetation conditions—fuels—are the primary driver of fire hazard. The project area generally consists of fire-adapted forest with fire return intervals ranging from 2 to 8 years and averaging five years, as well as grass and shrub-dominated vegetation types. Past management activities have altered the fuels matrix and fire patterns.

The historic range of variability for the piñon/juniper cover type within the project area suggest a fire regime generally characterized by frequent, patchy, low-severity fire burning in areas where fuel was available and only occasionally becoming widespread when fuel and weather conditions were conducive. This would have kept thin-barked tree species, such as junipers, in low abundance or limited to microsites where fires occurred less frequently. Such a fire regime would have supported a variety in forest structure from relatively open stands with a continuous herbaceous understory to spatially diverse stands, with openings, individuals, and clumps of trees.

The historic range of variability for the ponderosa pine cover type is associated with a frequent, low-intensity, low-severity fire regime (Barrett et al. 2010). It is among the forest types most heavily impacted by fire exclusion (Fitzgerald 2005; Skinner and Chang 1996; Agee 1993). These frequent, low-intensity fires maintained open stand structures with accumulated or randomly distributed overstory trees. Frequent, low-intensity fires also maintained sparse, light surface fuels by killing understory vegetation, such as shrubs, small trees, and seedlings, and by consuming ground fuels (Hessburg et al. 2005; Fitzgerald 2005; Skinner and Chang 1996; Agee 1993). This fire regime would have kept thin-barked, fire-intolerant tree species (for example, white fir and Rocky Mountain juniper) in low abundance or limited to microsites where fires occurred less frequently. The forest structure and fire regime as described would have supported understory species of grass and small shrubs. Reynolds et al. (2013) indicate the historical range for trees per acre for ponderosa pine forests of the southwestern United States was 11.7 to 124, with a mean of 38.4 trees per acre occurring in Carson, New Mexico.

Current piñon/juniper, ponderosa pine, and mixed conifer stands are overstocked, often even aged and multistoried, with few examples remaining of the historical open, fire-maintained stand conditions. Current stands contain more small trees, and fewer large trees than existed in the past, increasing the amount of ladder fuels (the connectivity of flammable trees and branches between the ground surface and the forest canopy), canopy bulk density (the mass of available canopy fuel), and dead forest fuels accumulations (surface fuels). A drier climate, combined with the interruption of historical fire return intervals, have resulted in an uncharacteristic accumulation of available wildland fuels across the project area. This increase in wildland fuels has increased fire hazard in the project area. Also, with interruption of fire return intervals, there has been an increase in fuel continuity and accumulations in the project area. This accumulation of fuels has increased the fire hazard and risk of severe effects from wildfire across the project area.

The project area has departed from the densities, structures, composition, and processes that have historically promoted conditions resilient to disturbances from wildfire, insects, disease, and changing climate. Desired environmental conditions for the project area would be more similar to those found historically, with lower tree densities, lower fuel loading, and a diverse mix of tree sizes and age classes intermixed with openings for new tree growth and native grass, forb, and shrub growth. Desired environmental conditions would also include sustained meadows, forage, and small openings for wildlife and livestock; reduced erosion particularly in riparian areas; and retention of native riparian species. Overall, the goal of the project would not be to mimic one condition in time but to reference conditions more resilient to disturbance and relatively rapid changes in climate. There is a need to move vegetation within the project area toward a condition that would increase tree vigor and forest health, reduce the susceptibility of uncharacteristic wildfire, and reduce the severity of disturbances from wildfire, insects, disease, and changing climate.

### *Fire Behavior Fuel Models*

A fire behavior fuel model represents the fuel bed characteristics necessary to predict surface fire behavior in fire behavior modeling systems.

Approximately 61 percent of the project area has been classified as potentially harboring fires that burn in the surface and ground fuels with greater fire intensity than the other timber litter models. Dead and down fuels resulting from over maturity or natural events create a large load of dead material on the forest floor. Crowning out, spotting, and torching of individual trees are more frequent in this fuel situation, leading to potential fire control difficulties. Fires of this type are at

the upper limit of control by direct attack. More wind or drier conditions could lead to an escaped fire (Anderson 1982).

Approximately 15 percent of the project area is classified as potentially harboring fire that is generally carried in the surface fuels that are made up of litter cast by the shrubs and the grasses or forbs in the understory.

Approximately 14 percent of the project area is classified as potentially harboring slow-burning ground fires with low flame lengths, although the fire may encounter an occasional "jackpot" or heavy fuel concentration that can flare up. Only under severe weather conditions involving high temperatures, low humidity, and high winds do the fuels pose fire hazards. Closed-canopy stands of short-needle conifers or hardwoods that have leafed out support fire in the compact litter layer.

Approximately 5 percent of the project area is classified as potentially harboring fires that run through the surface litter and have long flame length. Fall fires in hardwoods are predictable, but high winds will actually cause higher rates of spread than predicted because of spotting caused by rolling and blowing leaves (Anderson 1982).

### *Existing Fuel Condition and Fire Hazard*

Fuel conditions, including surface fuel loading levels, ladder fuels, and standing live and dead trees (snags) in the project area are a product of insect and disease activity, wildfire damage, storm damage, past vegetation management, and natural forest succession. Dense fuels, shown in figure 12, could promote a higher-intensity fire under adverse weather conditions. The location of the wildland-urban interface and private lands in the project area, combined with these fuel conditions, is of concern. If a wildfire were to occur in the area, suppression actions could be hampered by limited access or egress and hazardous fuels. It is expected the surrounding communities, businesses, campgrounds, transmission lines, Highway 64, the Taos Pueblo, and private inholdings would be severely impacted or damaged by the fire, smoke, or both as similarly witnessed during the Hondo and Encebado Fires.

**Figure 12. Fuel conditions in the project area (photo credit: K. Sanchez-Meador)**

### *Existing Fire Behavior Potential*

Fire behavior modeling was conducted to evaluate potential fire behavior characteristics for the project area. The fuel models that comprise over 75 percent of the project area were modeled for existing fire behavior potential without active management; the results are displayed in table 11. Under this scenario, potential fire behavior characteristics would make direct suppression strategies ineffective or unsafe for firefighters, making it necessary to utilize mechanized equipment, and possibly aircraft, for suppression activities. Given the current fire hazard under 90$^{th}$ percentile weather conditions, model results indicate a surface fire would transition to an active crown fire throughout the project area with a 5 mile per hour surface wind. With winds less than 5 miles per hour, a passive crown fire could be expected within the project area.

Local fire managers state fires generally spread due to spotting[27] and wind-driven crown fires. Any areas expected to experience passive or active crown fire have the potential for spotting. Fires initiating within these areas may threaten values and infrastructure within and adjacent to the project area. Conditions like these can lead to high acreage burned and significant adverse effects on resources (Scott and Reinhardt 2001).

[27] Spotting is defined as "Behavior of a fire producing sparks or embers that are carried by the wind and which start new fires beyond the zone of direct ignition by the main fire."

**Table 11. Summary of fire behavior modeling for the existing condition**

| Fire Behavior Fuel Model | Fuel Model 10 (Ponderosa Pine, Mixed Conifer) Existing Condition | Fuel Model 5 (Piñon/Juniper) Existing Condition |
|---|---|---|
| Flame length (feet[1]) | 9.2 | 11.6 |
| Rate of spread (chains per hour[2]) | 27.2 | 86.9 |
| Fireline intensity (British thermal units) | 709 | 1,167 |
| Crown fire activity | Yes | Yes |
| Able to engage fire with ground forces | No | No |

[1] Flame length is how long a flame is not how high the flame is.

[2] 1 chain = 66 feet

## 2.3.7 Environmental Consequences

### 2.3.7.1 Alternative 1 – Proposed Action, Forest Plan Amendments

Treatments on 9,709 acres would utilize conventional ground-based equipment, skyline yarders, harvesters and forwarders capable of operating on slopes of up to 75 percent, masticators, and equipment such as excavators capable of piling fuel on steep slopes. Alternative 1 would require forest plan amendments and is the preferred alternative from a fire and fuels standpoint. Amending the forest plan would benefit fire and fuels management because it would reduce fuels to a greater extent by allowing more intensive mechanical treatment within the project area, and it would be expected to correlate to a larger reduction in potential fire behavior across the project area.

### 2.3.7.2 Alternative 2 – No Forest Plan Amendments

Treatments on 9,709 acres would utilize conventional ground-based equipment, skyline yarders, harvesters and forwarders, masticators, and equipment such as excavators capable of piling fuel. Ground-based mechanical treatments would not occur on slopes greater than 40 percent. Hand thinning, using chainsaw, and hand piling would occur in areas of greater than 40 percent slope where mechanical treatment is restricted.

### 2.3.7.3 Direct and Indirect Effects - Alternative 1 and 2

With the removal of heavy surface fuels and the interruption of canopy fuels, modeling indicates fire suppression resources would have greater success suppressing undesirable fire ignitions within treated areas. With implementation of treatments, suppression resources could contain a fire since the average rate of spread would be less than 12.9 chains per hour and fireline intensities less than 84 British thermal units. Flame lengths would be expected to average 3 feet, and no crown fire activity would be expected. See table 12 for modeled potential fire behavior characteristics before and after treatment. Table 13 illustrates the contrast of expected fire behavior post treatment compared to the existing condition.

Under alternative 2, areas with limited access or where machinery is excluded on slopes greater than 40 percent, slash and larger coarse woody debris would be left on the ground until it is hand piled and pile burned. If a wildfire were to occur prior to disposing of residual slash, it is expected the wildfire would burn with higher intensities, rate of spread and flame lengths. These areas are expected to become a fuel model 10 or 11. After prescribed burning, it is expected these areas would become a fuel model 8 or 9.

**Table 12. Potential fire behavior characteristics post treatment as compared to the existing condition.**

| Fire and Fuels Resource Element | Resource Indicator | Measure | Existing Condition | After Treatment Alternative 1 | After Treatment Alternative 2 (areas excluded from machinery or with limited access) |
|---|---|---|---|---|---|
| Fire hazard | Severity | Percent of tree mortality | 65 to 77% | 5 to 10% | 5 to 10% |
| Crown fire hazard | Canopy base height | Increase height from ground | Canopy base height is less than 1 foot average | Canopy base height is 14 feet average | Canopy base height is 14 feet average |
| Crown fire hazard | Canopy bulk density | Less than .0062 lb/ft3 is desired | Canopy bulk density is .0129 pounds per cubic foot | Canopy bulk density is .0053 pounds per cubic foot | Canopy bulk density is .0053 pounds per cubic foot |
| Crown fire hazard | Fire type | Surface fire, passive crown fire, active crown fire | Crown fire activity = active | Crown fire activity = surface | Crown fire activity = surface and passive/torching |
| Surface fire hazard | Fuel model | Fireline intensity (British thermal units per foot per second) Average less than 100 | 938 average British thermal units per foot per second | Less than 84 average British thermal units per foot per second | 171-709 British thermal units per foot per second |
| Surface fire hazard | Flame length | Less than 4 feet is desired | Flame length = 10.4 average | Flame length = 3.05 average | Flame Length = 4.8-9.2’ |
| Surface fire hazard | Rate of spread | Average less than 18 chains per hour is desired | Rate of spread = 57 chains per hour average | Rate of spread = less than 12.9 chains per hour average | Rate of Spread= 12.1-27.2 |

**Table 13. Modeled fire behavior output comparison for existing condition, alternative 1, and alternative 2**

| Fire Behavior Fuel Model | Fuel Model 10-Ponderosa pine, Mixed Conifer Existing Condition | Fuel Model 5-Piñon/Juniper Existing Condition | Fuel Model 8-Ponderosa Pine, Mixed Conifer (After Treatment) | Fuel Model 9-Hardwood Litter (After Treatment) | Fuel Model 10 and 11 (Alt 2 -Areas excluded from machinery or with limited access.* |
|---|---|---|---|---|---|
| Flame length (feet[1]) | 9.2 | 11.6 | 1.6 | 4.5 | 4.8 to 9.2 |
| Rate of spread (chains per hour[2]) | 27.2 | 86.9 | 4.6 | 21.2 | 12.1 to 27.2 |
| Fireline Intensity (British thermal units) | 709 | 1,167 | 16 | 152 | 171 to 709 |

| Fire Behavior Fuel Model | Fuel Model 10-Ponderosa pine, Mixed Conifer Existing Condition | Fuel Model 5-Piñon/Juniper Existing Condition | Fuel Model 8-Ponderosa Pine, Mixed Conifer (After Treatment) | Fuel Model 9-Hardwood Litter (After Treatment) | Fuel Model 10 and 11 (Alt 2 -Areas excluded from machinery or with limited access.* |
|---|---|---|---|---|---|
| Crown fire activity | Yes | Yes | No | No | Surface and passive or torching |
| Able to engage fire with ground forces | No | No | Yes | Yes | No |

**With alternative 2, areas less than 40% slope would have fire behavior similar to alternative 1.

[1] Flame length is how long a flame is not how high the flame is.

[2] 1 chain = 66 feet

Implementing the treatments associated with alternative 1 or 2 would reduce surface, ladder, and crown fuels and subsequent fire behavior characteristics when compared to the existing condition. Raising canopy base heights and reducing tree density in mechanical thinning units would reduce ladder fuels and the potential for crown fire initiation. It is expected the fire behavior potential would be noticeably reduced with the proposed treatments, and the risk of wildfire impacts to adjacent private lands and other resource values would be reduced. Prescribed burns would be expected to create a mosaic of burned and unburned patches of vegetation on the surface and in the canopy. It is expected there would be openings of varying acreages and mortality in many of the smaller-diameter understory trees and shrubs (ladder fuels), as well as consumption of dead and down fuels.

Some stands would likely increase in size class as larger-diameter trees remain and would be more resilient to fire. With reduced stand densities, timber stands become more resilient to insect and disease, thereby reducing mortality of mature trees and further decreasing surface fuel loading levels.

Prescribed fire treatments would retain or promote more open stands by reducing understory brush species and young conifers and would help to maintain or shift areas towards the desired condition. It would help retain large-diameter overstory trees and reduce the risk of crown fire due to a reduction of ladder fuels in the understory. It would also enable the reintroduction of fire into a fire-adapted ecosystem.

In aspen restoration treatments, thinning within and around aspen clones has been shown to be an effective treatment for increasing aspen regeneration and restoring aspen. Prescribed burning has also been shown to be effective at promoting aspen regeneration (Shepperd 2001). Modifying canopy fuels may lead to increased surface fire intensity and spread rate under the same environmental conditions due to lower fine dead fuel moisture content and the proliferation of understory grasses and shrubs due to the increase exposure to light. Proposed treatments would begin to restore ecological processes, including the frequent low-to-mixed-severity fire regimes that historically occurred.

Hazardous fuels reduction treatment opportunities outside priority fuelbreak units may be limited or restricted in order to meet wildlife management requirements. Subsequently, this may affect fire behavior and fire suppression tactics should a wildfire occur or move into the project area.

However, it is anticipated any proposed hand treatment, mechanical treatment, or both and prescribed fire treatments would help reduce the risk of high-intensity, stand-replacing wildfires and reduce hazardous fuels.

The permanent road proposed under alternative 2, would benefit firefighting resources by allowing access to remote locations of the project area. If not maintained, it is anticipated the benefit would be temporary as shrubs, trees, and grasses regenerate.

#### *Forest Plan Amendment*

Amending the forest plan would benefit fire and fuels management by reducing fuels to a greater extent by allowing more intensive mechanical treatment within the project area. It is also likely activity fuels generated under alternative 1 would be disposed of more effectively due to mechanized equipment being allowed throughout more of the project area. Alternative 1 would be expected to correlate to a more effective reduction in potential fire behavior within the project area due to the availability of mechanized equipment to pile fuel in areas that would be hand-piled under alternative 2.

### 2.3.7.4 Cumulative Effects – Alternative 1 and 2

#### *Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis*

The cumulative effects analysis area was determined to be the area within the project boundary. Current and future activities that are occurring and would occur within the project area include, but are not limited to, maintenance and construction of trails, developed campgrounds and roads, livestock grazing, range water improvements, silvicultural treatments, fuels reduction activities, fuelwood collection, and wildfires.

For analyzing cumulative impacts to fire and fuels management, only activities including silvicultural treatments, wildfires, grazing, prescribed burning, fuels reduction, and fuelwood collection are discussed in more detail. Within the Pueblo Ridge Project area, approximately 364 acres of fuels reduction work has been accomplished between 2006 and 2013. The Capulin wildland-urban interface project completed 66 acre of fuels reduction work around private lands in the Pueblo Ridge project area. Management of the Capulin grazing allotment is ongoing and extends across the majority of the project area comprising 13,579 acres. Cattle grazing can benefit fire and fuels management by reducing fine fuels (grasses and forbs), thus reducing surface fire behavior potential in grazed areas. The Tri-State Power Company continues to maintain the power line right-of-way that runs through the project area.

In addition, Firewise hazardous fuels reduction work is occurring on private lands within and adjacent to the project area. This project would be important to the success of future fire suppression efforts and complements past treatments and those currently occurring or being proposed.

Cumulatively, these activities result in reductions in fire behavior potential to a greater degree due to the additional areas being treated. All activities discussed would cumulatively break up fuel continuity on the landscape by reducing surface, ladder, and crown fuels. These combined treatments would complement the purpose and need goals for fire and fuels management by reducing the risk for high-intensity, stand-replacing wildfires. Reducing hazardous fuels may also help reduce the likelihood of wildfire spreading onto private property and into drainages leading

into Taos Canyon and Taos Pueblo. It would enable fire managers to manage future wildfire ignitions under a variety of management objectives. These combined activities would greatly facilitate restoring and sustaining ecological processes in fire-dependent ecosystems and move vegetation and fuel conditions toward the desired natural fire regimes.

Past wildland fire events and management activities have had an effect on the landscape and would continue into the future. The existing condition has been influenced by wildfires and also fire exclusion, as well as natural and artificial activities including, but not limited to, insects and disease, weather events, prescribed fire, and past timber harvest. It is expected there would be no effects to vegetation and fuel conditions outside the analysis area boundary as a result of this project.

## 2.3.8 Summary

### 2.3.8.1 Degree to Which the Alternatives Address the Purpose and Need and Issues

With implementation of alternatives 1 or 2, areas historically classified as having a more frequent fire return interval would be treated, moving towards restoring the natural and historical fire regime. The Pueblo Ridge Restoration project area would benefit from the proposed treatments by reducing hazardous fuel levels to reduce the risk for high intensity and stand replacing wildfires. Prescribed fire treatments would reintroduce fire as a natural part of the ecosystem and reduce fuel buildup to help prevent the spread of wildfire. Forest health and resiliency would be improved by a reduction in stand densities. Fuel treatment opportunities outside of priority fuel break units may be limited or reduced in order to meet wildlife management requirements. However, it is expected meeting the purpose and need for fire management would also help protect Mexican spotted owl protected activity centers, potential habitats, and suitable nesting and roosting habitat locations from future stand-replacing wildland fires and enhance landscape-level forest resiliency to climate variability as stated in the 2012 Mexican spotted owl recovery plan (see “Wildlife” section).

The active management approach would comply with forest plan standards and guidelines, and Federal, State, and local law. This management approach would address management recommendations of the National Fire Plan and the Taos County Community Wildfire Protection Plan. The project’s purpose and need would be addressed by reducing the risk for high-intensity, stand-replacing wildfires; reintroducing fire as a natural part of the ecosystem; and reducing fuel buildup to help prevent the spread of wildfire onto private property and into drainages leading into Taos Canyon and Taos Pueblo area. Specifically, the fire risk and hazard in the treatment area would be reduced. Increasing canopy base height and decreasing canopy cover and canopy bulk density would reduce the potential for crown fire initiation and propagation.

Reducing stand density and fuel loading through group and individual tree selection and prescribed burning would change fire behavior such that surface fire could reasonably be expected within all treated areas under simulated conditions. The permanent road proposed under alternative 2, if maintained, would provide a benefit to firefighting resources by allowing access to remote locations of the project area.  If not maintained, it is anticipated the benefit would be temporary as shrubs, trees and grasses regenerate.

# 2.4 Air Quality

## 2.4.1 Introduction

The Carson National Forest must comply with Federal and State ambient air quality standards as mandated by the Clean Air Act. The Pueblo Ridge Restoration Project is designed to meet the goals, objectives, and standards set forth by the Federal and local regulatory framework. Permission to burn is based on air quality and dispersion forecasts. Public announcements are posted at nmfireinfo.com. Prescribed fire would occur when weather conditions and smoke dispersion forecasts are favorable as forecast by National Weather Service and New Mexico Environment Department personnel. All prescribed fire operations are conducted under the guidelines set forth and approved in a prescribed fire plan developed by fire managers. Prescribed fire plans include parameters for weather conditions, fuels, fire behavior, air quality, equipment, and personnel contingency resources.

The New Mexico Environment Department Air Quality Bureau has authority over air quality in New Mexico, except Bernalillo County and tribal lands. Prior to implementing prescribed burning, several requirements must be met. The burn must be registered at least two weeks prior to the planned ignition, and the Carson staff must notify New Mexico Environment Department personnel by 10 a.m. the day prior to ignition. In addition, burns are required to be timed when atmospheric conditions promote smoke dispersion to minimize impacts to the public.

### 2.4.1.1 Class I Areas

The Clean Air Act gives special air quality and visibility protection to national parks larger than 6,000 acres and national wilderness areas larger than 5,000 acres that were in existence when the act was amended in 1977. These are class I areas; all other areas are class II. Because air pollution is often regional in nature, reductions in pollution to improve visibility in class I parks will also improve visibility in all parks in the surrounding area. Class I areas are managed by the National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, and several Native American tribes (National Park Service 2018).

With respect to the Pueblo Ridge Restoration Project, the following Class I areas are located near the project area: the Pecos Wilderness lies approximately 21 miles south of the project area, the Wheeler Peak Wilderness lies approximately 8 miles north, the Bandelier Wilderness lies approximately 59 miles southwest, and the San Pedro Parks Wilderness lies approximately 70 miles west. The regional haze rule, promulgated by the Environmental Protection Agency (EPA), calls for State and Federal agencies to work together to improve visibility in class 1 areas. The rule requires States to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment. The Clean Air Act requires that Forest Service actions have no adverse effect on air resources by meeting the national ambient air quality standards and nondegradation standards for class I areas.

### 2.4.1.2 Nonattainment Areas

The Clean Air Act requires EPA staff to set national ambient air quality standards for six common air pollutants (also known as criteria air pollutants): carbon monoxide, lead, ground-level ozone, particulate matter10 and particulate matter 2.5, nitrogen dioxide, and sulfur dioxide. These pollutants can affect human health, reduce visibility, and lead to acidic deposition in sensitive, high-elevation lakes, and they are found all over the U.S. They can harm public health and the environment, and cause property damage (EPA.gov). If a community does not attain the national

ambient air quality standards for one or more of the criteria air pollutants, EPA personnel designate it a nonattainment area. States must demonstrate to the public and EPA staff how a nonattainment area would meet the standards, based upon the control of emission sources. Such demonstrations employ control plans that are part of each state implementation plan, including emissions from prescribed fire. Currently, Taos County is in attainment for the criteria air pollutants.

### 2.4.2 Environmental Consequences

Prescribed burning treatments would have direct, short-term impacts on air quality in the project area and possibly the surrounding areas. All proposed prescribed burning would occur when weather conditions and dispersion forecasts are favorable and risk of fire escape is low. All burning would take place under the guidelines in the prescribed fire plan which would be developed specifically for all project-related burning activities. Prescribed fire plans would address parameters for weather, air quality, contingency resources, and potential escapes. Transitory smoke from implementing alternative 1 or 2 could produce some smoky days in the local area and could also result in nuisance smoke, smell, or haze. Smoke would also be expected to settle into the lower draws and drainages during the evening hours following ignition. Prescribed burns would be registered with the New Mexico Environment Department, Air Quality Bureau staff, before prescribed burn implementation to ensure conformity with state implementation plans for emissions of regulated air pollutants.

Fugitive road dust is a result of motorized vehicle use on dry unpaved roads and is caused by the force of the wheels moving across the road surface pulverizing the surface material. Dust is then lofted by the rolling wheels and the turbulence caused by the vehicle itself. This air turbulence can persist for a period after the vehicle passes. The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Variables that influence the amount of dust produced are the average vehicle speed, vehicle weight, number of wheels per vehicle, the road surface texture, the fraction of road surface material classified as silt, and the moisture content of the road surface.

Moisture content of the road surface has the greatest influence on the amount of fugitive dust produced. Several activities may contribute to fugitive dust effects within the project area, including equipment and vehicle travel on National Forest System roads during mechanical and prescribed burning operations.

Two aspects of the purpose and need for this project are reducing the risk for high-intensity, stand-replacing wildfires and reducing fuel buildup to help prevent the spread of wildfire onto private property and into drainages leading into Taos Canyon and the Taos Pueblo area. Wildfires present a risk to public health and result in damage to both the environment and property. Wildfires are known to result in high levels of emissions, violations of associated national ambient air quality standards violation, and poor visibility.

Vegetation management treatments provide the opportunity, on a long-term basis, to reduce the magnitude of wildfire air quality problems. According to Wiedinmyer and Hurteau (2010), widescale prescribed fire application can reduce carbon dioxide fire emissions for the western U.S. by 18 to 25 percent.

The total amount of pollutants released by prescribed burning would be spread out over several years and would occur when emissions would be unlikely to have adverse effects on human health and visibility. It is expected treatments would decrease fire intensity, severity, and emissions if a wildfire occurs in the project area. All prescribed burning activities would be in accordance with

Federal, State, and local requirements to ensure no impacts to class 1 areas occur. After implementation, it is estimated subsequent wildfires in the project area could produce less pollutants due to less fuel available to burn.

### 2.4.3 Cumulative Effects

Air quality within the Camino Real Ranger District is potentially affected by land management and development activities both on and off the Carson National Forest. Sources of air pollutants are wildland and prescribed fires, fuelwood collection, fuels reduction projects, watershed restoration projects, utility line rights-of-way maintenance and installation, timber management activities, travel management (maintenance and construction), road dust, campfires, and vehicle emissions from daily traffic. These sources, as well as industrial sources and emissions from developments (wood burning stoves, vehicles, and burning) on lands of other ownership, have an overall effect on the air quality of the Camino Real Ranger District. Cumulative effects on air quality from implementing alternative 1 or 2 would be an incremental decrease in air quality as pollutants from prescribed burning with this project combine with other particles produced by the implementation of other aspects of this project, including fugitive road dust from equipment during mechanical operations and burning operations. Emitted pollutants effects on an area depend on atmospheric conditions at the time. Pollutants can be cumulative with emissions from many local and regional sources, including other forests; State, tribal, or private projects being implemented; wildfires; vehicles; industrial sources; buildings; and agriculture. Because of the widespread, short-lived impacts of emissions, no other projects were explicitly considered for cumulative impact analysis. It is impossible to predict what pollution sources may be present at the time of a prescribed fire or a wildland fire occurring at an unspecified date in the future.

## 2.5 Wildlife

### 2.5.1 Resource Indicators and Measures

Resource indicators and the associated measures are utilized to analyze and disclose potential project effects on wildlife and habitat. More specifically, these measures are quantifiable and sensitive to change. Not all resource indicators are applicable to all species or habitat types and not all potential effects are described as resource indicators. It is assumed project activities would affect the measures by changing the existing conditions. The resource indicators selected for this project for terrestrial wildlife are listed in  and are further explained in the “Existing Conditions” section.

**Table 14. Resource indicators and measures for assessing project effects to wildlife and habitat.**

| Resource Element | Resource Indicator | Measure | Source (Laws, Regulation, or Policy) |
|---|---|---|---|
| Wildlife habitat | Cover and habitat type or keystone habitat feature (also referred to as suitable habitat). Specific language for Mexican spotted owl applies. | Acres, stream miles, or habitat feature (for example, number of springs or snags) affected | Endangered Species Act, forest plan, Forest Service handbook and manual direction |
| Wildlife habitat | Forest structure - Diameter distribution. Specific requirements for northern goshawk applies. | Vegetation structural stage classes | Forest plan, Forest Service handbook and manual direction |

| Resource Element | Resource Indicator | Measure | Source (Laws, Regulation, or Policy) |
|---|---|---|---|
| Old growth | Old growth allocation | Acres of old growth forest present after allocation | Forest plan |

## 2.5.2 Existing Conditions

### 2.5.2.1 Cover and Habitat Type or Keystone Habitat Feature

In general, suitable habitat for a species is considered any habitat where a species could potentially or does occur. More specifically, the specific species may breed, forage, or perform necessary behaviors to ensure natural history requirements are met within this habitat. Because this varies between species, the number of acres or stream miles of species-specific habitats or the presence or change in keystone features are analyzed within the appropriate species section of this document. A keystone habitat feature is defined as a habitat element a species relies on to persist within the environment, such as snags or roosting trees.

### 2.5.2.2 Forest Structure - Diameter Distribution

The Goshawk Scientific Committee developed the vegetation structural stages desired condition guidelines (Reynolds et al. 1992) which were later adopted as part of the forest plan. This ecosystem management approach defines structural stage guidelines and recommendations for goshawk habitat. The forest structure of wildlife habitat can determine whether some species will be present or absent. The stages range from 1 to 6. Vegetation structural stage 1 stands are the youngest (shade-intolerant stage) and primarily consist of grasses, forbs, shrubs, seedlings, and saplings less than one-inch in diameter. Vegetation structural stage 6 stands are mature forests consisting largely of trees greater than 24 inches in diameter (shade-tolerant stage). Habitat containing a variety of vegetation structural stage classes is preferred by many wildlife species.

Current conditions are dominated by even-aged and uneven-aged stand structures in ponderosa pine and mixed conifer forests, and uneven-aged piñon/juniper woodlands within the project area (Table 15). Most ponderosa pine and mixed conifer stands in the project area fall within vegetation structural stages 3, 4, and 5. Reynolds et al. (2013) define even-aged forests as comprised of one or two distinct age classes and uneven-aged forests as comprised of three or more distinct age classes.

**Table 15. Size class distribution (acres and percent of forest cover type) within all stands, Pueblo Ridge project area.**

| Forest Cover Type | VSS 1 (0-0.9" DBH*) | VSS 2 (1-4.9" DBH) | VSS 3 (5-11.9" DBH) | VSS 4 (12-17.9" DBH) | VSS 5 (18-23.9" DBH) | VSS 6 (24"+) | Total Acres | Percent of Total Acres |
|---|---|---|---|---|---|---|---|---|
| Aspen | 0 (0%) | 112 (24%) | 141 (30%) | 206 (43%) | 17 (4%) | 0 (0%) | 476 | 4.9 |
| Ponderosa pine | 0 (0%) | 40 (1%) | 684 (25%) | 849 (30%) | 649 (24%) | 554 (20%) | 2,776 | 28.5 |
| Mixed conifer | 138 (4%) | 0 (0%) | 1,048 (27%) | 1,938 (50%) | 561 (15%) | 170 (4%) | 3,855 | 44.1 |
| Engelmann spruce-subalpine fir | 0 (0%) | 0 (0%) | 0 (0%) | 26 (45%) | 0 (0%) | 25 (44%) | 51 | 0.6 |

| Forest Cover Type | VSS 1 (0-0.9" DBH*) | VSS 2 (1-4.9" DBH) | VSS 3 (5-11.9" DBH) | VSS 4 (12-17.9" DBH) | VSS 5 (18-23.9" DBH) | VSS 6 (24"+) | Total Acres | Percent of Total Acres |
|---|---|---|---|---|---|---|---|---|
| Gambel oak | 0 (0%) | 41 (23%) | 87 (48%) | 0 (0%) | 55 (30%) | 0 (0%) | 183 | 1.8 |
| Piñon/juniper | 0 (0%) | 0 (0%) | 0 (0%) | 907 (38%) | 1,441 (48%) | 20 (1%) | 2,368 | 24.3 |
| Total acres | 139 | 194 | 1,959 | 3,923 | 2,726 | 769 | 9,709 | 100 |
| Percent of total acres | 1.4 | 2.0 | 20.2 | 40.4 | 28.1 | 7.9 | 100 | NA |

DBH = Diameter at breast height. It is the measurement of the diameter of the stem of a tree measured approximately 4.5 feet above ground on the uphill side. VSS = vegetation structural stage. NA = not applicable.

### 2.5.2.3 Forest Structure - Stand Density and Old Growth

Information about the stand density and old growth in the project area is found in the "Silviculture and Forestry" section, which concluded much of the project area is at risk of density-related mortality and 23.3 percent of the project area contains structure or characteristics of old-growth conditions

### 2.5.2.4 Desired Conditions

The need for the proposed action has been determined by comparing the existing conditions to the desired conditions. Desired conditions are based on the most recent, best available science, as well as knowledge of the historic range of variability and standards and guidelines from the forest plan. The forest plan was amended in 1996 to include standards and guidelines for Mexican spotted owl habitat, northern goshawk habitat, and old growth allocation. Some of these specific conditions are outlined in table 166.

**Table 16. Specific desired conditions compared to current conditions for resource indicators as analyzed within this document.**

| Resource Indicator | Existing Condition | Desired Condition |
|---|---|---|
| Forest structure - diameter distribution (vegetation structural stage) in ponderosa pine within treatment areas | VSS 1: 0%; 0 acres<br>VSS 2: 1%; 40 acres<br>VSS 3: 25%; 684 acres<br>VSS 4: 31%; 849 acres<br>VSS 5: 23%; 649 acres<br>VSS 6: 20%; 554 acres | VSS 1: 10%; 278 acres<br>VSS 2: 10%; 278 acres<br>VSS 3: 20%; 555 acres<br>VSS 4: 20%; 555 acres<br>VSS 5: 20%; 555 acres<br>VSS 6: 20%; 555 acres |
| Old growth allocation within the project boundary | Piñon/juniper: 44%; 1,038 acres<br>Ponderosa pine: 32%; 880 acres<br>Mixed conifer: 10%; 368 acres<br>Spruce and spruce/fir: 0%; 0 acres | Piñon/juniper: 20%; 475 acres<br>Ponderosa pine: 20%; 557 acres<br>Mixed conifer: 20%; 783 acres<br>Spruce and spruce/fir: 20%; 12 acres |

VSS = vegetation structural stage

## 2.5.3 Species Considered for this Analysis

A list of threatened, endangered, and proposed species to consider for the Pueblo Ridge Project was obtained from the U.S. Fish and Wildlife Service Information, Planning, and Conservation System (U.S. Fish and Wildlife Service 2020). Five species were reviewed for known or potential occurrence within the project area (Table 17). Mexican spotted owl and Canada lynx are the only two listed species carried forward for further analysis. Twenty-five species on the Southwestern Region sensitive species list (USDA Forest Service 2013) are applicable to the Camino Real Ranger District and were also reviewed (Table 18). Of these, nine were carried forward for further analysis. Table 17 also provides a final determination resulting from the analysis. In addition to the analyses for Mexican spotted owl and Canada lynx, a detailed analysis for northern goshawk is provided in this document to show application and consistency with project design features. Eleven management indicator species applicable to the Camino Real Ranger District. Of the eleven, eight species were carried forward for further analysis (Table 19). Detailed analysis for all wildlife species considered, including migratory birds, is provided in the "Wildlife" report, available in the project record.

**Table 17. Threatened, endangered, or proposed species considered for this analysis**

| Species | Habitat or Known Occurrence | Determination (Alternatives 1 and 2) |
|---|---|---|
| Mexican spotted owl (*Strix occidentalis lucida)* - threatened | Present | May affect, not likely to adversely affect |
| Canada lynx (*Lynx canadensis*) - threatened | Present | May affect, not likely to adversely affect |
| Southwestern willow flycatcher (*Empidonax traillii extimus)* - endangered | Not present | No effect |
| Yellow-billed cuckoo (*Coccyzus americanus*) - threatened | Not present | No effect |
| New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) - endangered | Not present | No effect |

**Table 18. Sensitive species considered for this analysis**

| Species | Habitat or Known Occurrence | Determination (Alternatives 1 and 2) |
|---|---|---|
| Northern leopard frog (*Lithobates pipiens*) | Present | May affect individuals but is not likely to result in a trend toward listing or a loss of viability |
| Northern goshawk (*Accipter gentiles*) | Present | May affect individuals but is not likely to result in a trend toward listing or a loss of viability |
| Cinereus (masked) shrew (*Sorex cinereus cinereus*) | Present | May affect individuals but is not likely to result in a trend toward listing or a loss of viability |
| Water shrew (*Sorex palustris navigator*) | Present | May affect individuals but is not likely to result in a trend toward listing or a loss of viability |
| Spotted bat (*Euderma maculatum*) | Present | May affect individuals but is not likely to result in a trend toward listing or a loss of viability |
| Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*) | Present | May affect individuals but is not likely to result in a trend toward listing or a loss of viability |
| Nokomis fritillary (*Speyeria nokomis nokimis*) | Present | May affect individuals but is not likely to result in a trend toward listing or a loss of viability |
| Robust larkspur (*Delphinium robustum*) | Potentially present | May affect individuals but is not likely to result in a trend toward listing or a loss of viability |
| Arizona willow (*Salix arizonica*) | Potentially present | May affect individuals but is not likely to result in a trend toward listing or a loss of viability |
| Bald eagle (*Haliaeetus leucocephalus*) | Not present | No effect |
| American peregrine falcon (*Falco peregrinus anatum*) | Not present | No effect |
| White-tailed ptarmigan (*Lagopus leucurus*) | Not present | No effect |
| Burrowing owl – western (*Athene cumicularia hypugaea*) | Not present | No effect |
| Boreal owl (*Aegolius funereus*) | Not present | No effect |
| American pika (*Ochotona princeps saxatilis*) | Not present | No effect |
| Gunnison's prairie dog (*Cynomys gunnisoni*) | Not present | No effect |
| American marten (*Martes americana origenes*) | Not present | No effect |
| Rio Grande sucker (*Castostomus plebeius*) | Not present | No effect |
| Rio Grande chub (*Gila pandora*) | Not present | No effect |
| Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*) | Not present | No effect |
| Roundtail chub (*Gila robusta*) | Not present | No effect |
| Sangre de Cristo pea-clam (*Pisidium sanguinichristi*) | Not present | No effect |
| Yellow lady's slipper (*Cypripedium parviflorum* var. *pubescens*) | Not present | No effect |
| Alpine larkspur (*Delphinium alpestre*) | Not present | No effect |
| Pecos (hairless) fleabane (*Erigeron subglaber*) | Not present | No effect |

**Table 19. Management indicator species considered for this analysis**

| Management Indicator Species | Key habitat component | Habitat Occurrence | Comments/Determination |
|---|---|---|---|
| ***Birds (5)*** | | | |
| Brewer's sparrow (*Spizella breweri*) | Sagebrush | not present | The project area lacks sagebrush habitat. This project would not affect forest-wide habitat and population trends. |
| plain (juniper) titmouse (*Baeolophus ridgwai*) | Piñon/juniper canopies | present | Analysis required. Refer to the 2.5.6 *Management Indicator Species* section below. |
| white-tailed ptarmigan (*Lagopus leucurcus*) | Alpine tundra and subalpine deciduous shrub | not present | Treatment areas are below alpine tundra and subalpine deciduous shrub zones (10,500 feet). This species was also analyzed in the *Biological Evaluation* section of this document. Alternatives 1 and 2 would not affect forest-wide habitat and population trends |
| hairy woodpecker (*Picoides villosus*) | snags | present | Analysis required. Refer to the 2.5.6 *Management Indicator Species* section below. |
| wild turkey (*Meleagris gallopavo*) | old growth pine | present | Analysis required. Refer to the 2.5.6 *Management Indicator Species* section below.Refer to the *Potential for Effects* section. |
| ***Mammals (4)*** | | | |
| Rocky mountain bighorn sheep (*Ovis canadensis canadensis*) | alpine, subalpine tundra and mountain meadow grassland | not present | Treatment areas are below alpine and subalpine tundra biotic zones and do not include areas of high elevation grassland. Therefore, alternatives 1 and 2 would not affect forest-wide habitat and population trends. |
| Abert's squirrel (*Sciurus aberti*) | Interlocking canopies in ponderosa pine | present | Analysis required. Refer to the 2.5.6 *Management Indicator Species* section below. |
| red squirrel (*Tamiasciurus hudsonicus*) | Mixed conifer | present | Analysis required. Refer to the 2.5.6 *Management Indicator Species* section below. |
| Rocky Mountain elk (*Cervis elaphus nelsoni*) | General forest | present | Analysis required. Refer to the 2.5.6 *Management Indicator Species* section below. |
| ***Aquatic species (2)*** | | | |
| resident trout | perennial stream, riparian vegetation | present | Analysis required. The Rio Grande Cutthroat Trout was already analyzed within the *Biological Evaluation* section of this document. Therefore, this analysis only includes the Rainbow Trout (*Oncorhynchus mykiss*) and Brown Trout (*Salmo trutta*). Refer to the 2.5.6 *Management Indicator Species* section below. |
| aquatic macroinvertebrates | perennial stream, riparian vegetation | present | Analysis required. Refer to the 2.5.6 *Management Indicator Species* section below. |

## 2.5.4 Endangered, and Proposed Species

Potential effects of alternatives 1 and 2 on threatened, endangered, and proposed species are analyzed within this section. The project area does not contain proposed or designated critical habitat for any federally listed species. There are three potential options for habitat occurrence for each species: present, not present, or present but not affected. The following species require further analysis: Mexican spotted owl and Canada lynx.

An effect determination for both alternatives will be made for all species within the project area. The effects determinations are as follows:

- no effect: no impacts (positive or negative) to listed species or resource
- may affect, but not likely to adversely affect: all effects are beneficial, insignificant, or discountable
- may affect, likely to adversely affect: listed resources are likely to be exposed to the action and will respond negatively
- may affect, beneficial effect: effects to listed resources are entirely beneficial

#### 2.5.4.1 Mexican Spotted Owl

The U.S. Fish and Wildlife Service Mexican spotted owl recovery plan was revised in 2012 and terminology for Mexican spotted owl habitat was updated from the 1995 recovery plan. Alternative 1 includes a forest plan amendment to update planning and analysis to the most recent guidance and direction from U.S. Fish and Wildlife Service. However, planning and analysis will follow terminology and standards and guidelines from the 1995 Mexican spotted owl recovery plan under alternative 2 which does not include forest plan amendments. The 1995 Mexican spotted owl recovery plan is consistent with the 1996 amendment to the Carson forest plan (USDA Forest Service 1986) and will be used until the forest plan is revised, unless alternative 1 is selected. If alternative 1 is selected, it would modify the forest plan for the Pueblo Ridge Restoration Project to use guidance in the 2012 Mexican spotted owl recovery plan. The survey protocol remains the same for both the 1995 and the 2012 recovery plan. The three categories of Mexican spotted owl habitat are described below for both the 1995 and 2012 recovery plans.

In the 1995 recovery plan (U.S. Fish and Wildlife Service 1995), protected habitat consists of areas that are occupied nest or roost areas, areas with a slope greater than 40 percent in mixed conifer and pine-oak forests where timber harvest has not occurred in the past 20 years, and administratively reserved lands (U.S. Fish and Wildlife Service 1995). In the 2012 recovery plan, protected habitat areas are defined as protected activity centers which refer to areas that encompass a minimum of 600 acres surrounding known owl nest or roost sites. Alternative 1 utilizes parameters outlined in the 2012 recovery plan to delineate existing suitable nesting and roosting habitat, which is referred to as “suitable nesting and roosting habitat”. Acres of protected habitat within treatment areas is modeled using the definition in the 1995 recovery plan for alternative 2.

In the 1995 recovery plan, restricted habitat consists of areas outside of the protected activity centers which have potential nesting or roosting areas and foraging, dispersal, and wintering habitats (U.S. Fish and Wildlife Service 2012). It consists of habitats such as pine-oak, mixed conifer, and riparian areas (U.S. Fish and Wildlife Service 1995). It was renamed recovery habitat in the 2012 recovery plan, but the attributes did not change. However, a clearer description of riparian and forested recovery habitat was provided (U.S. Fish and Wildlife Service 2012). For purposes of this analysis, restricted habitat will be used in lieu of recovery habitat in alternative 2.

In the 1995 recovery plan, the last category consists of other forest and woodland types. This includes ponderosa pine and spruce/fir forests, piñon/juniper woodlands, and aspen (*Populus* spp.) groves that appear to be little used by nesting Mexican spotted owls but are likely used for foraging and dispersal (U.S. Fish and Wildlife Service 1995). In the 2012 recovery plan, other forest and woodland types are defined as those areas consisting of vegetation types that are neither restricted nor within protected activity centers (U.S. Fish and Wildlife Service 2012). There are no specific management guidelines for this habitat. Summaries of current Mexican spotted owl habitat management direction adopted from the 1995 recovery plan, as well as habitat management recommendations provided in the 2012 recovery plan, are provided in appendices G and H.

### *Species Description*

In general, Mexican spotted owls will nest, roost, forage, and disperse in a wide variety of habitats from rocky canyons to piñon/juniper woodland to spruce/fir depending on the geographic region. However, roosting and nest habitats are generally in shade-tolerant forests with mature trees or in rocky canyon areas (U.S. Fish and Wildlife Service 2012) in mature mixed conifer or mature ponderosa pine forests (Ganey et al. 2011; U.S. Fish and Wildlife Service 2012). Forests used for nesting are generally uneven aged, multistoried, and have high canopy cover (U.S. Fish and Wildlife Service 2012). In rocky areas, the owls will nest and roost in protected caves or on sheltered ledges (U.S. Fish and Wildlife Service 1995). In northern New Mexico, Mexican spotted owl nest and roost sites are usually associated with steep-walled, relatively narrow canyons; high canopy cover; saplings in the understory; and rocky outcrops (U.S. Fish and Wildlife Service 2012). Timing of breeding is range dependent but generally consists of courtship occurring in March, followed by eggs in late March or early April and hatching in May. Owlets fledge early-to-mid June (U.S. Fish and Wildlife Service 2012). Fidelity to breeding sites is very high, and most owls return to the same territory year after year (U.S. Fish and Wildlife Service 2012).

Research is limited on foraging habitat because it is difficult to observe foraging behavior of this species at night. However, Mexican spotted owls appear to use a wider variety of cover types with more varied structure for foraging compared to nesting and roosting habitats (Ganey et al. 2003; U.S. Fish and Wildlife Service 2012). Mexican spotted owls will forage in all roosting habitats but will not roost in all forested stands in which they forage (Ganey et al. 2003; U.S. Fish and Wildlife Service 2012). Habitats used for foraging vary from forested, riparian, and meadow habitat types, including areas burned from fire and cliff faces and terraces between cliffs (U.S. Fish and Wildlife Service 2012). In general, forested foraging areas consist of closed-canopy forests with high basal area and a high volume of logs (U.S. Fish and Wildlife Service 2012). Mexican spotted owls' diet varies by geographic location, but they will consume small- and medium-sized mammals, such as woodrats, mice, and voles, as well as rabbits, bats, birds, reptiles, and insects (U.S. Fish and Wildlife Service 2012). The prey species listed above have habitat needs varying from rock outcroppings and high shrub components (woodrats and chipmunks) to high herbaceous cover (rabbits) to high tree densities (red squirrels) and areas of exposed soil (deer mice).

Threats to this species and its habitat include stand-replacing wildfire, vegetation treatments (such as wildland-urban interface treatments and silvicultural treatments), insect and disease infestation, grazing, and land and transportation development (U.S. Fish and Wildlife Service 2012).

### *Affected Environment*

There are no known occurrences or designated protected activity centers within either the Pueblo Ridge treatment areas or the project boundary. The nearest protected activity center is located on the Santa Fe National Forest, approximately 31 miles south of the Pueblo Ridge Restoration project area. During a regionwide occupancy survey, a single owl was detected in 2016 (unknown sex) and 2018 (male), respectively, approximately 1.5 miles south of the Pueblo Ridge project boundary. Forest Service biologists conducted a follow-up survey after each detection within the respective year; no additional owls were detected, and no breeding was confirmed.

Approximately 4,141 acres (41 percent) of the Pueblo Ridge project area were surveyed for Mexican spotted owls in 2015 as part of the Tri-State, Hernandez to Black Lake Transmission Line Access Project. No owls were detected during the two-year protocol survey. The first year of surveys totaling 3,854 acres in the northern section of the Pueblo Ridge project area were completed in 2019. No spotted owls were located. Mexican spotted owl survey coverage within the project area from 2015 through 2019 totals 6,886 acres.

Approximately 3,855 acres of mixed conifer exist within the project area. Existing VSS distribution for mixed conifer in the project area is largely dominated by moderate to dense stands in medium size classes with nearly 64% of mixed conifer occurring in stands from 5 to 18 inches diameter with canopy cover 60 percent or greater (3C, 4B, and 4C VSS classes; Table 20). Less than 85 acres (5%) of mixed conifer consists of dense stands in size classes 18 inches diameter or greater (VSS 5C, 6C; Trees < 18 inches dbh, canopy cover ≤60%) described by Ganey et al. (2003) as meeting Mexican spotted owl nesting habitat structural requirements in mixed conifer (Table 20). By comparison, the Carson National Forest contains an estimated 8,500 acres of stands with diameters 20 inches or greater, 60 percent or greater canopy, in mixed conifer.

**Table 20. Mixed conifer vegetation structural size classes within within the project area.**

| Vegetation Structural Size Class | Acres | Percent of Existing Mixed Conifer |
|---|---|---|
| 1 | 138 | 3.6 |
| 2 | 0 | 0 |
| 3A | 124 | 3.2 |
| 3B | 395 | 10.2 |
| 3C | 529 | 13.7 |
| 4A | 0 | 0 |
| 4B | 993 | 25.8 |
| 4C | 945 | 24.5 |
| 5A | 14 | 0.4 |
| 5B | 503 | 13.0 |
| 5C | 44 | 1.1 |
| 6A | 0 | 0 |
| 6B | 131 | 3.4 |
| 6C | 39 | 1.0 |
| TOTAL | 3,855 | 100.0 |

### Alternative 1

Management of Mexican spotted owl habitats under this alternative prescribes to recommendations provided in the 2012 Mexican spotted owl recovery plan (U.S. Fish and Wildlife Service 2012). Suitable habitat for this species is modeled in terms of parameters of mixed conifer stands described in the 2012 recovery plan and existing and potential nesting and roosting habitats were identified according to the amounts and structural characteristics in table C.3 of the recovery plan, shown below in table 21.

**Table 21. Minimum desired conditions for mixed conifer and pine-oak forest areas managed for recovery nesting and roosting habitat in the Southern Rocky Mountains ecological management unit**

| Forest Type | Percent of Area[1] | Percent Basal Area by Size Class 12 to 18 in dbh | Percent Basal Area by Size Class Greater than 18 in dbh | Minimum tree Basal Area[2] | Minimum Density of Large trees[3] |
|---|---|---|---|---|---|
| Mixed conifer | 25 | More than 30 | More than 30 | 120 feet | 12 |

1 Percent of area pertains to the percent of the planning area, subregion, region, or a combination of these areas in the specified forest type that should be managed for threshold conditions.

2 Basal areas in square feet per acre and include all trees more than1 inch in diameter at breast height (any species).

3 Trees larger than 18 inches in diameter at breast height (dbh). Density is trees per hectare (trees per acre).

Approximately 562 acres (14 percent of existing mixed conifer within the project area) consists of suitable nesting/roosting habitat in the project area. Because this amount represented less than 25 percent of existing mixed conifer in the project area as recommended in the 2012 Recovery Plan, an additional 679 acres (18 percent of mixed conifer) containing habitat attributes nearest those prescribed in table 21 were identified for management to develop suitable nesting/roosting habitat as quickly as possible to meet the 25 percent recommendation (figure 13). Stands identified for management as nest/roost habitat equate to about 32 percent of existing mixed conifer. Approximately 2,614 acres of recovery habitat constitutes the remaining mixed conifer stands.

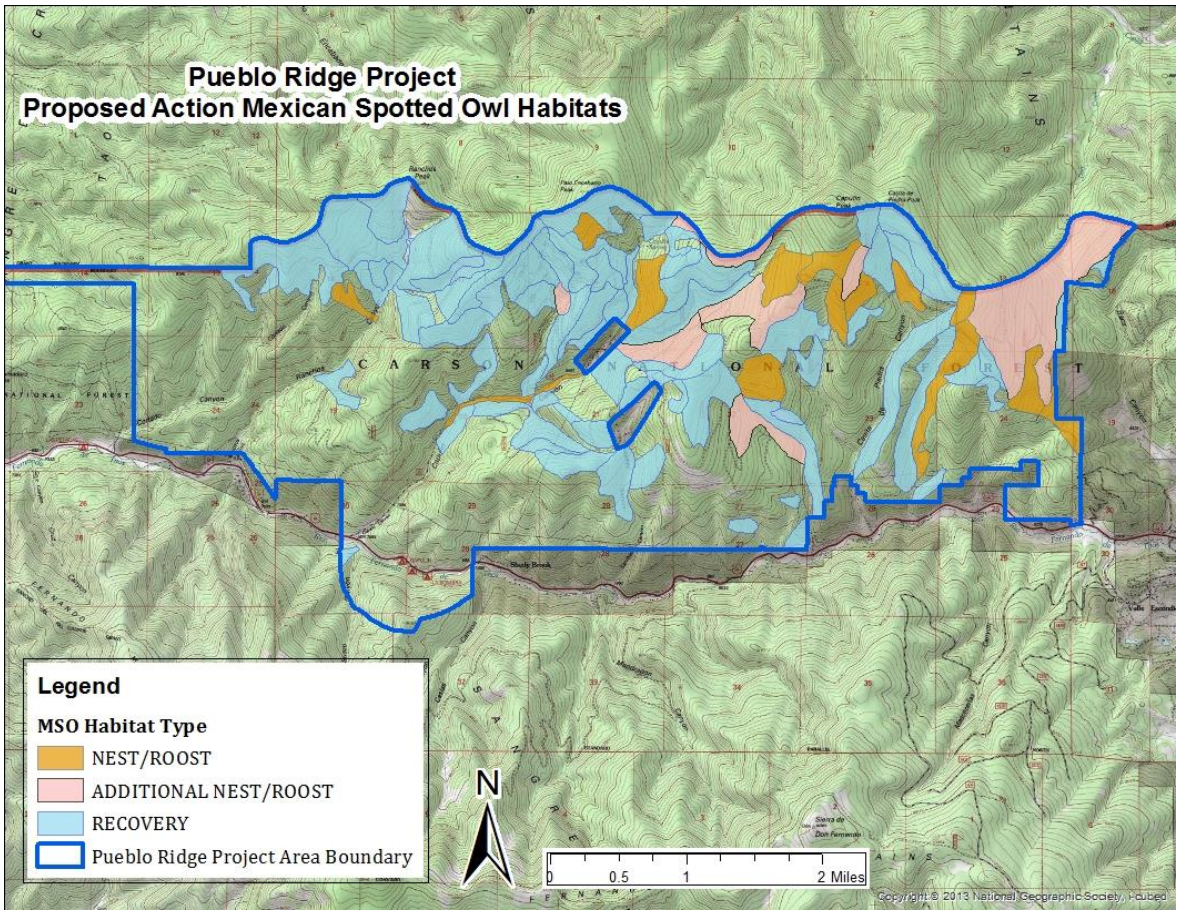


**Figure 13. Mexican spotted owl habitat according to the 2012 recovery plan, Pueblo Ridge project area**

### Alternative 2

Suitable spotted owl habitat for this alternative is modeled in terms of protected and restricted habitat, as described above in the forest plan. Previous forestwide habitat models were updated for this project resulting from more accurate stand cover type identification provided by stand exam data overlain with topographic slope models. Protected areas include delineated protected activity centers—mixed conifer forests with slopes greater than 40 percent where timber harvest has not occurred in the last 20 years. No reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas occur within the project area. Restricted habitat consists of mixed conifer stands outside protected habitats.

There are approximately 1,836 acres of protected habitat and 4,462 acres of restricted habitat mapped in types within the project area for a total of 6,298 acres of managed spotted owl habitat.

## *Environmental Consequences*

### Alternative 1 Direct and Indirect Effects

Vegetation and fuels treatments described in table 3 may be applied within 562 acres of nest and roost habitat; however, stand structural attributes (described in table 21 as meeting minimum thresholds for nesting and roosting habitat suitability) would be maintained after treatment for all 562 acres. These same activities may also be implemented within additional nest and roost stands. Because the acreage amount of stands delineated for management as suitable habitat (32 percent of existing mixed conifer) exceeds the 2012 Recovery Plan recommendation of 25 percent,

management of additional nest and roost stands to obtain suitable habitat characteristics described in table 21 as soon as possible would be required on 402 acres of additional nest and roost habitat. Management toward suitable habitat characteristics on 277 acres of additional nest and roost habitat would be optional, thereby allowing management flexibility in selecting the location of stands to be managed at higher densities (toward nest and roost characteristics) to meet 2012 Recovery Plan recommendations while meeting the purpose and need identified for reducing wildfire risk, particularly within fuelbreak units.

Management of Mexican spotted owl habitats consistent with 2012 Recovery Plan recommendations is expected to result in adequate availability of suitable habitat that is sustainable over time. However, as noted by Ganey and others (2016), there may be some risk in omitting consideration of canopy cover in evaluating suitable Mexican spotted owl nesting or roosting habitat. While stands identified as nesting or roosting and additional nesting roosting stands within the project would meet suitable habitat attributes for basal area and trees per acre as defined in the 2012 Recovery Plan, residual stand canopy cover values would range from 50 to 58 percent, which falls below recommendations of 60 percent (Ganey et al. 2003).

About 150 acres of spotted owl nest and roost habitat and 278 acres of additional nest and roost habitat (34 percent of all nest and roost and additional nest and roost habitats) occurs within proposed fuel break treatment units. Because these treatment prescriptions are designed to reduce fire spread within the project area, they are expected to benefit spotted owl habitat overall by reducing risk of loss to stand replacement fire both for these units and nesting and roosting habitats outside these units. As stated above, an excess of 277 acres of additional nest and roost habitat exists, allowing management the option of adjusting treatment type in order to reduce wildfire risk where these stands overlap fuelbreak units.

Vegetation and fuels treatments in spotted owl recovery habitats, while reducing canopy cover and basal area, would adhere to management recommendation in the 2012 Recovery Plan. Treatments would retain stand attributes contributing to the potential for development into future nesting and roosting habitat while accelerating stand development and reducing the potential for stand replacement fire and loss of key attributes including large trees and snags. Approximately 1,600 acres of recovery habitat overlaps with proposed fuelbreak treatment units where prescriptions may involve removal of some trees greater than 18 inches in order to meet the purpose and need of the project. The 2012 Recovery Plan recognizes that treatments adequate to meet fuels and restoration management objectives in recovery habitats may result in the short-term loss of some habitat components in areas that could be occupied by spotted owls and that these losses are acceptable where they result from actions that otherwise further longer-term protection and sustainability of forests occupied by owls. Implementation of fuel break prescriptions is expected to reduce risk of losing existing nesting and roosting habitats to stand replacement fire by reducing risk of fire spread within the project area. Therefore, the project retains a sufficient balance of density and distribution of important features that spotted owls may require while reducing the risk of losing existing roosting and nesting habitat from stand-replacing fires.

The project area currently contains no known spotted owl protected activity centers or individual spotted owl occurrences, although comprehensive surveys have not been conducted over the entire project area. Prior to implementation of management activities, protocol surveys for spotted owls will be conducted in all potentially suitable habitats. If spotted owls are determined to occur, management recommendations concerning core areas and protected activity centers as outlined in the 2012 Recovery Plan would be implemented in order to maintain or enhance suitable habitat and reduce risk of disturbance (see "Design Features" section above). Any potential negative effects to nesting owls or their habitat due to noise would be avoided by means of management guidelines and project design. During the non-nesting period, owls or prey individuals occurring within or adjacent to treatments would likely move out of the disturbed area into adjacent, undisturbed habitat. This disturbance would be short term and localized in nature. Thus while the foraging behavior of individual owls and prey may temporarily be affected by project activities, their overall ability to feed, reproduce, nest, roost, and conduct other life-history behaviors would not be permanently adversely impacted, so this temporary disturbance is considered insignificant and discountable.

Approximately 213 acres of old growth overlaps with spotted owl nesting and roosting habitat. Stands that have been identified for allocation can be considered old growth or are on the appropriate path to developing into the old-growth category. All stands at or above suitability thresholds identified in the 2012 recovery plan would be managed to meet or exceed those thresholds.

No new system roads would be created under this alternative. Reroute of existing system roads and temporary road construction of up to 5 miles would occur during implementation to allow access to thinning units. Use of temporary roads could increase disturbance during project implementation if owls are nearby during the nesting season. However, the risk is low because suitable habitats would be surveyed for owls prior to implementation, and areas around positive owl sites would be restricted by a limited operating period. The temporary roads would be decommissioned once the project is completed. Decommissioning 13 miles of closed roads under both action alternatives would limit illegal motorized trespass and provide an indirect benefit by reducing potential disturbance.

Other proposed activities under alternative 1, including restoration treatments, road management, and range improvements, are expected to have minimal impacts on existing spotted owl habitat. If owls are determined present within the project area, project design criteria would apply to minimize risk of disturbance and impacts to habitat.

### Alternative 2 Direct and Indirect Effects

Approximately 1,836 acres of protected habitat and 4,462 acres of restricted habitat mapped within the project area could be affected by project activities. This represents approximately about 4 percent and 7 percent, respectively, of protected and restricted habitat within the Camino Real Ranger District (table 22).

**Table 22. Protected and restricted Mexican spotted owl habitats in the mixed conifer forest type**

| Mexican Spotted Owl Suitable Habitat Type | Acres within Project Boundary | Acres within District Boundary | Percentage of Habitat in Camino Real Ranger District |
|---|---|---|---|
| Protected | 1,836 | 41,963 | 4% |

| Mexican Spotted Owl Suitable Habitat Type | Acres within Project Boundary | Acres within District Boundary | Percentage of Habitat in Camino Real Ranger District |
|---|---|---|---|
| Restricted | 4,462 | 60,441 | 7% |

There is currently an overabundance of trees within the vegetation structural stages 3 and 4 size classes, which indicates a departure from preferred Mexican spotted owl habitat of mature and seral trees (trees within and greater than the vegetation structural stage 4 size class). In addition, the current conditions indicate stand structure is relatively even, with fewer trees represented on the landscape in the small (less than 4.9 inches in diameter at breast height) and larger (greater than 18 inches in diameter at breast height) vegetation structural stage size classes.

Treatment prescriptions' protected habitats would adhere to management guidelines described in the forest plan consisting of restricting thinning treatments to trees 9 inches in diameter at breast height and retention of woody debris larger than 12 inches and trees and snags greater than 10 inches in diameter. Treatments would retain 170 square feet of basal area in 10 percent of restricted habitats (approximately 390 acres) as well as 150 square feet of basal area in an additional 15 percent of restricted habitats (approximately 560 acres). A minimum of 20 trees per acre 18 inches or larger would be retained, as would 10 percent of existing stand density index for each of diameter size classes 12 to 18 inches, 18 to 24 inches, and 24 inches or greater. In addition, treatments would remain consistent with forest plan direction by incorporating natural variation in tree density, incorporating uneven-aged management, maintaining represented species, retaining trees 24 inches or greater in diameter at breast height, and utilizing prescribed fire, as well as emphasizing adequate snag, down log, and hardwood retention.

The project area currently contains no known spotted owl protected activity centers or individual spotted owl occurrences, although comprehensive surveys have not been conducted over the entire project area. Prior to implementation of management activities, protocol surveys for spotted owls would be conducted in all potentially suitable habitats. If spotted owls are determined to occur, management recommendations concerning core areas and protected activity centers as outlined in the forest plan would be implemented in order to maintain or enhance suitable habitat and reduce risk of disturbance (see "Alternative 2 Project Design Features" section). Any potential negative effects to nesting owls or their habitat due to noise would be avoided by means of management guidelines and project design.

Up to 5 miles of new system road would be created under this alternative; access would be managed as maintenance level 1 (closed) after project implementation is completed. Therefore, potential increase in disturbance if nesting owls become established in the vicinity would be short term. Reroute of existing system roads and temporary road construction of up to 5 miles would occur during implementation to allow access to thinning units. Use of temporary roads could also increase disturbance during project implementation if owls are nearby during the nesting season. However, the risk is low because suitable habitats would be surveyed for owls prior to implementation, and areas around positive owl sites would be restricted by a limited operating period. The temporary roads would be decommissioned once the project is completed.

Decommissioning 13 miles of closed roads under both action alternatives would limit illegal motorized trespass and provide an indirect benefit by reducing potential disturbance.

Other proposed activities under alternative 2, including restoration treatments, road management, and range improvements, are expected to have minimal impacts on existing spotted owl habitat. If owls are determined present within the project area, project design criteria would apply to minimize risk of disturbance and impacts to habitat.

Approximately 20 percent (368 acres) of the mixed conifer habitat within the project boundary was designated as old-growth allocation in accordance to the forest plan. Within this allocation, there are 221 acres of Mexican spotted owl protected and 107 acres of restricted habitat. Treatments in protected habitats would retain existing overstory density and stand suitability while reducing understory densities. Treatments in restricted habitat may reduce stand densities below the threshold of suitability, if it currently exists.

### *Cumulative Effects*

Past, present, and reasonably foreseeable activities that overlap in time and space with the treatment areas could have a cumulative effect on the Mexican spotted owl and its habitat. As a species with specific nesting and roosting requirements but more flexible foraging habitat, areas outside protected and restricted habitat were considered. These activities are grazing, recreation, and historical timber management and prescribed fire projects.

The project area has historically been grazed for several hundred years. Currently, the Capulin, Fernandez, East Fernandez, and Tienditas allotments are active within the Pueblo Ridge cumulative effects analysis area. Herbaceous areas (including grasslands) and riparian habitats have been affected by historical and ongoing grazing activities on Federal lands and private lands. Heavy grazing in the past (before grazing management by Forest Service personnel) likely altered plant species composition and reduced the amount of riparian and grassland habitat available. Historical grazing would had a negative effect on the Mexican spotted owl due to the loss of prey species, changes to timber stand structure, and removal of fuels for natural wildfires. Currently, grazing is actively managed; however, some site-specific riparian areas or prey habitat with herbaceous cover could still be negatively impacted. Additional sunlight from tree removal and prescribed fire would encourage the growth of ground cover which is often used as forage for cattle and as forage and cover for prey species for the Mexican spotted owl.

It is reasonable to assume recreational activities (such as camping, hiking, horseback riding, and hunting, among others) have occurred in the past and would continually occur within treatment areas during project implementation. It is likely there may be an additive effect of noise and human presence, but this disturbance is likely short term because project and recreation activities would not occur without interruption for extended periods of time. If owls or prey individuals are present, they would likely relocate to adjacent, undisturbed habitat and would return when recreation and project activities cease.

Timber stands adjacent to treatment areas containing suitable Mexican spotted owl habitat have been altered by previous and current timber, fuelwood, and prescribed fire projects. These projects are listed in appendix B. Districtwide dead and down permits and latilla permits may also change stand composition and the amount of down logs that contributes to Mexican spotted owl and prey species habitat. These combined activities likely opened the canopy and increased grass and shrub availability to owl prey species. The improved stand condition and forest health resulting from these treatments within the cumulative effects analysis area likely has a cumulative benefit to the owl, unless excessive down wood is harvested or many large, mature trees are poached within designated fuelwood units. In addition, these treatments contribute to an overall improved

resiliency to wildfires and pest and pathogens across the landscape that could potentially destroy habitat for this species.

The combination of grazing, recreation, and other activities may have an incremental effect on the Mexican spotted owl by potentially displacing foraging owls or prey species and reducing potential habitat for prey. However, spotted owl ability to conduct life-history behaviors would not be adversely impacted, so cumulative effects are considered minimal.

#### *Determination*

Due to the limited temporary negative effects on habitat or individuals and the likelihood, reduction in risk of habitat loss to stand-replacement fire, and consistency with management recommendations contained in the 2012 recovery plan of improved habitat quality after implementation activities, alternatives 1 and 2 may affect but are not likely to adversely affect the Mexican spotted owl.

### 2.5.4.2 Canada Lynx

#### *Species Description*

Lynx habitat in the Southern Rockies, including northern New Mexico, is characterized by Engelmann spruce and subalpine fir forest above 9,000 feet in elevation (Interagency Lynx Biology Team 2013; U.S. Fish and Wildlife Service 2014). These higher-elevation spruce/fir forests are habitat for snowshoe hare, the primary prey for lynx (Interagency Lynx Biology Team 2013; U.S. Fish and Wildlife Service 2014).

Lynx historically occurred in Colorado, but it is uncertain if they also occurred in New Mexico (Interagency Lynx Biology Team 2013). Lynx were reintroduced to Colorado from 1999 to 2006, including into the San Juan Mountains in southern Colorado. Radio-collar data shows some of these reintroduced lynx range into northern New Mexico (Interagency Lynx Biology Team 2013).

Habitat in and around the project area is part of the southern end of the San Juan Mountains and is more or less an extension of suitable lynx habitat located in Colorado. However, the overall conditions in northern New Mexico are not adequate to support a self-sustaining population of lynx (Interagency Lynx Biology Team 2013). For instance, snowshoe hare are present but much less abundant, and snowpack is less persistent than in Colorado (Interagency Lynx Biology Team 2013).

According to the 2014 revised designation, lynx from Colorado may disperse into northern New Mexico; however, habitats are not likely to support a self-sustaining population (U.S. Fish and Wildlife Service 2014). An earlier analysis of extending protection for lynx to New Mexico concluded that management of suitable lynx habitat in New Mexico should aim to support dispersing individuals long enough for their return to more suitable habitat in Colorado (U.S. Fish and Wildlife Service 2009).

#### *Affected Environment*

Patches of suitable lynx habitat are present (spruce/fir forest above 9,000 feet in elevation); however, they are relatively small and fragmented compared to the much larger aggregations needed to support breeding female lynx (U.S. Fish and Wildlife Service 2014). Furthermore, a study from Colorado found reintroduced lynx were selecting den sites, on average, above 11,000 feet in elevation (Interagency Lynx Biology Team 2013), approximately 600 feet higher than any high point in and around the Pueblo Ridge project area.

The guidance in the revised designation for Canada Lynx (U.S. Fish and Wildlife Service 2014) clearly defines essential habitat for conserving lynx as having high densities of snowshoe hare and persistent snow pack and being large enough to support multiple female lynx home ranges, which average 29 square miles (18,560 acres) in Colorado (U.S. Fish and Wildlife Service 2014). Potentially suitable habitat within the project area consists of 51 acres of spruce/fir forest; therefore, conditions in the project area do not fully meet these criteria. In particular, areas with suitable stands of spruce/fir above 9,000 are relatively small (several stands totaling 51 acres) and fragmented and cover much less area than that necessary to support even one female lynx home range.

The northeast portion of the project area contains approximately 57 acres of potential lynx habitat in Engelmann spruce forest cover type (figure 14). No historical or recent lynx observations have been reported within 10 miles of the project area boundary. The project area is located approximately 60 miles from the nearest extant lynx population in Colorado. No mapped lynx analysis units or linkage areas occur within the project area.

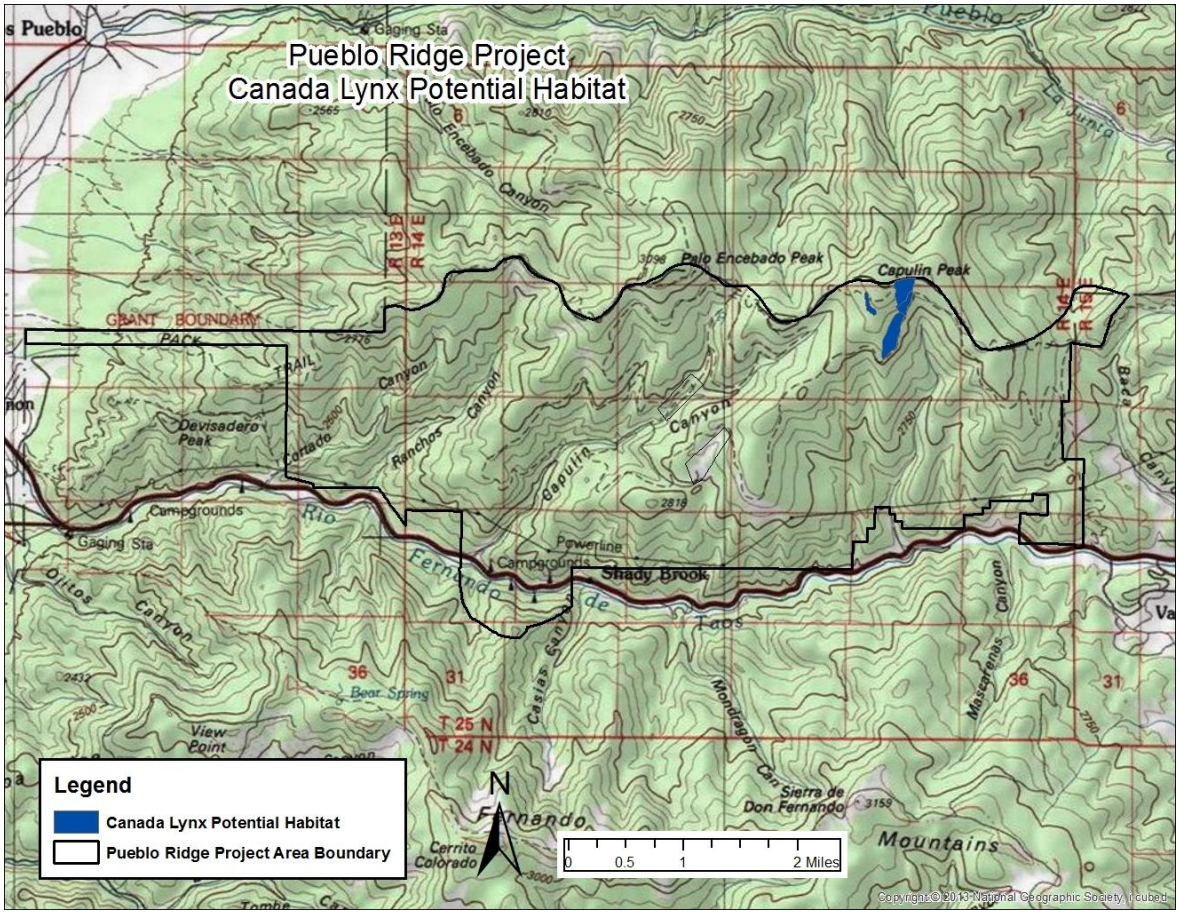


**Figure 14. Canada lynx potential habitat, Pueblo Ridge project area**

## *Environmental Consequences*

### Alternatives 1 and 2 Direct and Indirect Effects

The actions under both alternatives include treatments in lynx habitat (spruce/fir forest types). Treatments in the 4 units containing the spruce cover type include aspen restoration, thinning from

below to 40 percent canopy closure, and thinning from below to 120 square feet of basal area. Treatments would reduce overstory cover and understory density within stands, thereby reducing the potential to support lynx prey species such as snowshoe hare and red squirrel. However, retention of canopy cover in excess of 30 percent for all units would likely retain adequate cover to support lynx movements through the area. Portions of these units are located within the northern fuelbreak along the boundary with Taos Pueblo lands. While habitat quality would be reduced, treatments are expected to reduce the potential from fire spread and potential for stand-replacement fire from the project area into more suitable spruce stands on north-facing aspects north of the project area (see "Fire and Fuels" section). It is possible individual lynx, dispersing into New Mexico from Colorado, may be present in the project area. Disturbance from project activities may temporarily affect these local, dispersing individuals by displacing them from the project area, but overall, the effects would be minimal and would not result in any measureable changes to lynx behavior. Actions would not affect an individual's ability to seek food, cover, shelter, reproduce, or move through the project area; therefore, proposed actions in either alternative would not adversely impact this species.

Under both alternatives, use of temporary roads could increase disturbance during project implementation in the unlikely event lynx are nearby, but the effects likely consist only of temporary displacement during implementation. Temporary roads would be decommissioned once the project is completed.

Under alternative 2, up to 5 miles of new system road would be created in lower elevations outside potential lynx habitat. Decommissioning 13 miles of closed roads under both action alternatives would limit illegal motorized trespass and provide an indirect benefit by reducing potential disturbance.

**Cumulative Effects**

Past, present, and reasonably foreseeable activities that overlap in time and space with the treatment areas could have a cumulative effect on the Canada lynx and its habitat. These activities are grazing, recreation, and historical timber management, and prescribed fire projects.

The project boundary has historically been grazed for several hundred years. Currently, the Capulin, Fernandez, East Fernandez, and Tienditas allotments are active within the Pueblo Ridge cumulative effects analysis area. Herbaceous areas (including grasslands) and riparian habitats has been affected by historical and ongoing grazing activities on Federal lands and private lands. Heavy grazing in the past (before grazing management by Forest Service personnel) likely altered plant species composition and reduced the amount of habitat available for both lynx and prey species. Historical grazing would had a negative effect on lynx due to the loss of habitat for prey species, changes to timber stand structure, and removal of fuels for natural wildfires, which reduce the complex stand habitat preference for the Canada lynx. Currently, grazing is actively managed; however, some site-specific prey habitat with herbaceous cover could still be negatively impacted.

It is reasonable to assume recreational activities (such as camping, hiking, horseback riding, and hunting, among others) have occurred in the past and would continually occur within proposed treatment areas during project implementation. There may be an additive effect of noise and human presence, but this disturbance is likely short term because project and recreation activities would not occur without interruption for extended periods. If lynx or prey individuals are present, they would likely relocate to adjacent, undisturbed habitat and would return when recreation and project activities cease. The combination of grazing, recreation, and other activities may have an incremental effect on the Canada lynx by potentially displacing dispersing lynx or prey species and reducing potential habitat for prey. However, lynx ability to conduct life-history behaviors would not be permanently adversely impacted, so cumulative effects are considered minimal.

**Determination**

The action alternatives may reduce habitat suitability on 51 acres and temporarily alter the behavior of individual lynx temporarily dispersing from Colorado to New Mexico. However, there is no evidence of lynx occurrence or potential for home range persistence in the project area. In addition, treatments on 51 acres would not affect lynx movements at the landscape level. Therefore, the effects of the proposed action are likely insignificant or discountable for the Canada lynx; thus the proposed actions in both alternative 1 and 2 may affect but are not likely to adversely affect the Canada Lynx.

## 2.5.5 Forest Service Southwestern Region Sensitive Species

Southwestern Region sensitive species for the Camino Real Ranger District on the Carson National Forest are addressed in this section. There are three potential options for habitat occurrence for each species: present, not present, or present but not affected. Analysis for the following species can be found in the "Wildlife" report in the project record: northern leopard frog, cinereus (masked shrew), water shrew, spotted bat, pale Townsend's big-eared bat, Nokomis fritillary, robust larkspur, and Arizona willow.

The effects determinations for both alternatives for all Southwestern Region sensitive species are as follows:

- no effect: no impacts (positive or negative) to listed species or resource
- beneficial effect: effects to a species or resource are entirely beneficial
- may affect but is not likely to result in a trend toward listing or a loss of viability: individuals or their habitats are likely exposed to the action, but effects are beneficial, minimal, or discountable and the species or resource as a whole will persist
- may affect and is likely to result in a trend toward listing or a loss of viability: species or resources are likely to be exposed to the action and will respond negatively and populations would decrease as a result

### 2.5.5.1 Northern Goshawk

#### *Species Description*

In the Southwest, northern goshawks are forest generalists and use a variety of forest types for breeding and foraging (Reynolds et al. 1992); however, they are habitat specialists with respect to forest structure (Greenwald et al. 2005; Reynolds et al. 2006). The habitat components that make up a home range are described according to three different spatial scales: nest area (approximately

20 to 25 acres), post-fledging area (approximately 300 to 600 acres), and foraging area (approximately 5,000 to 6,000 acres) (Reynolds et al. 1992).

Northern goshawk nest site habitat selection varies in size, although goshawks prefer areas of high canopy closure, large tree size (vegetation structural stages 5 and 6), great density of large trees, and abundant coarse woody debris (Greenwald et al. 2005; Reynolds et al. 2006). These selected characteristics for both nest sites are consistent with mature to old-growth forests. Many nest areas are also on slopes with northern exposures or in drainages or canyon bottoms (Reynolds et al. 1992). Northern goshawks occupy nesting areas from early March until September and often build multiple nests within an area prior to choosing one for breeding, which may be used in subsequent years (Reynolds et al. 1992).

Post-fledging family areas surround nest areas and are used by adults and fledging birds learning to hunt (Reynolds et al. 1992). Post-fledging family areas generally contain a mosaic habitat patches with a variety of structural characteristics, including patches similar to nest areas (large, living trees, high canopy cover, etc.) along with openings and patches with younger and mid-aged trees with cover, as well as understories containing habitat critical to the life-histories of goshawk prey species (Reynolds et al. 1992).

Goshawk foraging habitat contains a variety of forested age classes and openings with ample snags, down logs, woody debris, and herbaceous and shrubby understories where goshawks can search for prey species residing within these habitats (Reynolds et al. 1997; Reynolds et al. 2006). Within ponderosa pine forests, goshawks select foraging sites with high canopy closure, greater tree density, and greater density of large trees compared to unused areas (Beier and Drennan 1997), with some males moving toward piñon/juniper forests in the winter (Drennan and Beier 2003). Goshawks prey on small-to-medium birds and mammals such as American robins, mourning doves, red and tassel-eared squirrels, and rabbits (Reynolds et al. 1992; Squires and Reynolds 1997).

Threats to this species include mature tree harvest and uncharacteristic wildfires (NatureServe 2015b).

### *Affected Environment*

There are no reported goshawk occurrences or northern goshawk nest sites within the project boundary. Surveys were conducted in the southern section (approximately 40 percent of the project area) in 2011 as part of the Tri-State Hernandez to Black Lake Transmission Line Access Project. No goshawks were detected during those surveys. Due to more than five years elapsing prior to the last survey, additional surveys for northern goshawks would be conducted prior to implementation.

The forest plan, in conjunction with the General Technical Report RM-217 (Reynolds et al. 1992), outlines appropriate forest structure variables to meet northern goshawk habitat preferences. Landscapes outside of post-fledging family areas within ponderosa pine and mixed conifer, and spruce/fir forests consists of 10 percent vegetation structural stage 1, 10 percent vegetation structural stage 2, 20 percent vegetation structural stage 3, 20 percent vegetation structural stage 4, 20 percent vegetation structural stage 5, and 20 percent vegetation structural stage 6 (table 23). Differences shown between existing and desired vegetation structural stage classes include deficits in early structural stages (vegetation structural stages 1, 2), an overabundance of medium and large (vegetation structural stages 4, 5) structure stands, and less than desired amounts of very large (vegetation structural stage 6) structure.

**Table 23. Existing and desired vegetation structural stage of ponderosa pine, mixed conifer, and spruce/fir forest types within the Pueblo Ridge project area**

| Vegetation Structural Stage (VSS) | Existing Condition within Treatment Areas | Desired Condition within Treatment Areas | Discrepancy Between Existing and Desired |
|---|---|---|---|
| VSS 1 (0 to 9”DBH) | 2.1% to 137 acres | 10% to 670 acres | -8% |
| VSS 2 (1 to 4.9” DBH) | 0.6% to 40 acres | 10% to 670 acres | -9.4% |
| VSS 3 (5 to 11.9” DBH) | 25.9% to 1,732 acres | 20% to 1,336 acres | +5.9% |
| VSS 4 (12 to 17.9” DBH) | 42.0% to 2,813 acres | 20% to 1,336 acres | +22.1% |
| VSS 5 (18 to 23.9” DBH) | 18.2% to 1,210 acres | 20% to 1,336 acres | -1.9% |
| VSS 6 (24+” DBH) | 11.2% to 749 acres | 20% to 1,336 acres | -8.8% |

DBH = diameter at breast height

**Nesting Habitat:** Reynolds and others (1992) describe structural attributes of goshawk nesting habitat by forest cover type. Those attribute values, including trees per acre, mean diameter, basal area, and canopy cover, were queried for this project to represent existing goshawk nesting habitat, which totals 1,045 acres and occurs primarily in mixed conifer and ponderosa pine stands located in the eastern portion of the project area (figure 15).

**Foraging Habitat:** Reynolds and others (1992) describe prey species habitat requirements according to forest type, size, and density. Common prey species including American robin, blue grouse, woodpeckers, sapsuckers, and red squirrels utilize a wide variety of forest habitat types ranging from open early structure stands to dense stands with large trees, but goshawk foraging habitat consists primarily of forests with relatively open understories and large trees. These forests are in older age classes with moderate overstory cover (40 to 60 percent) and well-developed herbaceous and shrub layers. Stands contain small to medium openings (less than 4 acres) and patches of dense mid-aged forests with large tree components (live trees, snags, and down logs) scattered throughout the foraging area. The large tree components often occur in clumps with interlocking crowns.

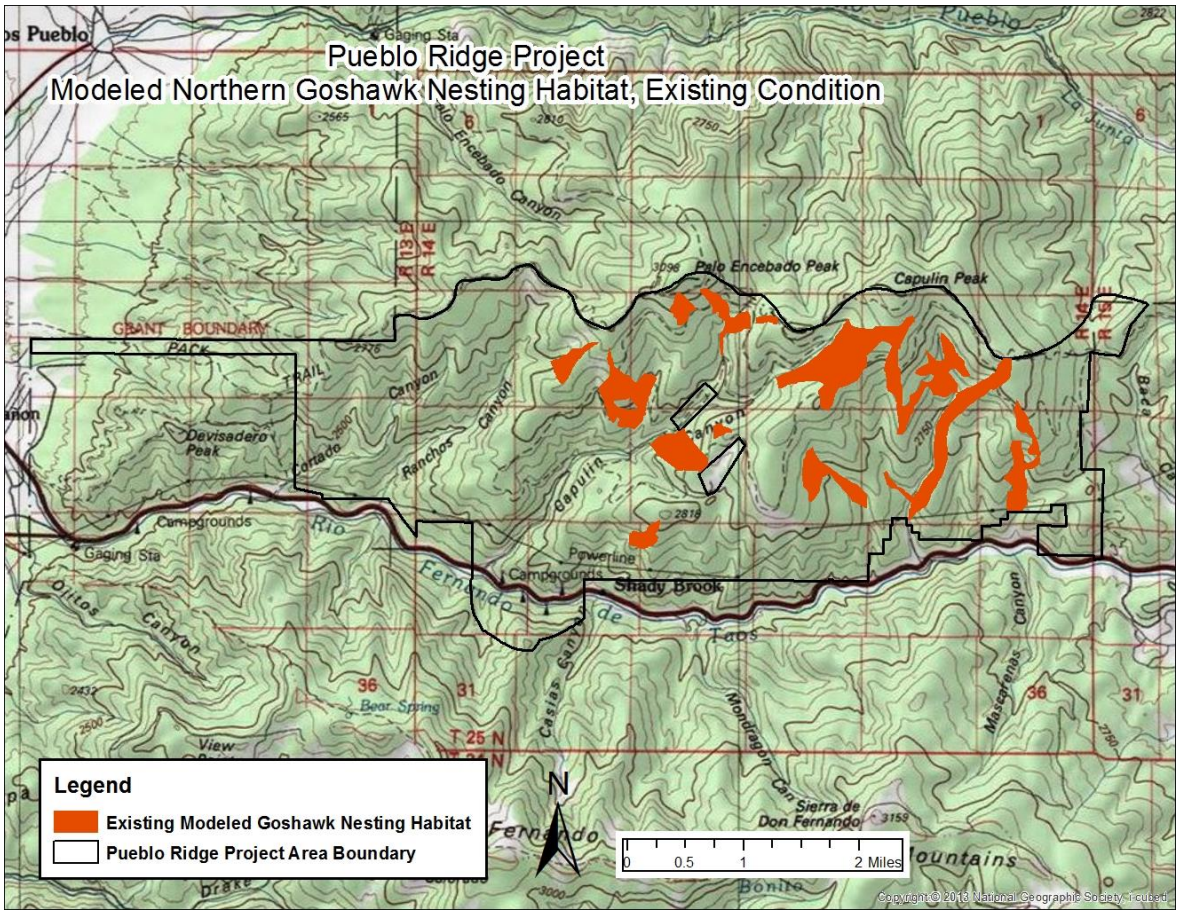


**Figure 15. Northern goshawk modeled nesting habitat, existing condition**

## *Environmental Consequences*

### Alternative 1

Alternative 1 would incorporate the best available science for restoration in frequent-fire forests (Reynolds et al. 2013), including clarifying language for northern goshawk management. This guidance document provides a framework for managing dry, frequent-fire forests, and integrates ecosystem restoration, fuels reduction, and encourages more resiliency to undesired disturbance events such as high severity wildfires, and improving habitat for goshawks.

One of the key concepts in General Technical Report-310 (Reynolds et al. 2013) is moving from homogenous to more diverse habitat structures will support a more diverse vertebrate prey base for goshawks. Thus, by following the report (Reynolds et al. 2013), proposed treatments would provide benefits to a range of wildlife species. For instance, the basic design that would guide mechanical thinning treatments is to create small openings (interspaces) with a stronger herb-forb-grass component, while retaining patches or clumps of trees with interlocking canopies. The result would be a greater diversity of habitat structures within a given area (mid-scale).

Noise from vehicle traffic and machinery from project activities (for example, cutting and removing trees, improving system roads, or cutting and scattering slash) would temporarily displace both foraging northern goshawks and their prey if present during implementation activities. Any present foraging goshawks or prey individuals would likely move out of the disturbed area into adjacent, undisturbed habitat. This disturbance would likely be short term and localized in nature, consisting of phased tree removal and traffic over the summer months.

Prescribed fire is expected to have similar effects to individuals by disturbing foraging northern goshawks and their prey during implementation. Displaced goshawks can forage in adjacent, undisturbed habitat. Both goshawks and prey are expected to return after the area revegetates following a prescribed burn.

No new system roads would be created under this alternative. Reroute of existing system roads and temporary road construction of up to 5 miles would occur during implementation to allow access to thinning units. Use of temporary roads could increase disturbance during project implementation if goshawks are nearby during the nesting season. However, the risk is low because suitable habitats would be surveyed for goshawk nesting presence prior to implementation and areas around goshawk nest sites would be restricted by a limited operating period.

Existing modeled goshawk nesting habitat within the project area totals about 1,045 acres. Proposed treatments under alternative 1 would reduce basal area and canopy cover values to below those prescribed as meeting nesting requirements (Reynolds et al. 1992) on approximately 793 acres (76 percent) of existing nest stands, potentially limiting goshawk nesting opportunities within the project area. Stand density reductions within proposed fuelbreak units are expected to benefit goshawk habitat overall by reducing the potential for stand-replacement fire inside and outside the project area.

Nesting goshawks currently utilizing the project area would not be negatively affected as treatment areas would be surveyed prior to implementation and management guidelines would be followed to avoid any negative effects to breeding or breeding habitat.

Under alternative 1, vegetation and fuels treatments would increase available early structure as well as open canopy moderate-aged and mature forest stands, while reducing amounts of dense moderate-aged and mature forest structure for all forest types considered (table 24). Mature stands with 40 to 60 percent canopy cover described as optimal goshawk foraging habitat by Reynolds and others (1992) would be reduced only slightly overall.

**Table 24. Goshawk habitat size class amounts (acres), existing condition and post-treatment, alternative 1.**

| VSS Class | Existing Condition | Alternative 1 Post Treatment | Change |
|---|---|---|---|
| 1 | 138 | 259 | +121 |
| 2 | 40 | 0 | -40 |
| 3 | 1,732 | 540 | -1,192 |
| 4 | 2,813 | 3,290 | +477 |
| 5 | 1,210 | 2,090 | +880 |
| 6 | 749 | 1,130 | +381 |

VSS = vegetation structural stage

Proposed treatments are expected to maintain adequate amounts of habitat to maintain most prey species and result in increases of prey associated with open mature stands, such as cottontails and golden-mantled ground squirrels. However, reductions in dense, moderate-aged, and mature habitats may limit red squirrel availability as a prey source. While treatments would reduce existing goshawk nesting habitat, post-treatment conditions under both alternatives would reduce the risk of stand-replacement fire and resulting habitat loss in comparison to the existing condition (see the "Fire and Fuels" section).

### Alternative 2 Direct and Indirect Effects

Nesting goshawks currently utilizing the project area would not be negatively affected as treatment areas would be surveyed prior to implementation and management guidelines would be followed to avoid any negative effects to individuals and associated nesting habitat.

Noise from vehicle traffic and machinery from project activities (for example, cutting and removing trees, improving system roads, or cutting and scattering slash) could temporarily displace both foraging northern goshawks and their prey during implementation activities. Any present foraging goshawks or prey individuals would likely move out of the disturbed area into adjacent, undisturbed habitat. This disturbance would likely be short term and localized in nature, consisting of phased tree removal and traffic over the summer months.

Prescribed fire would be expected to have similar effects to individuals by disturbing foraging northern goshawks and their prey during implementation. Displaced goshawks could forage in adjacent, undisturbed habitat. Both goshawks and prey would be expected to return after the area revegetates following a prescribed burn.

In general, forested stands within the project area would be managed to maintain quality habitat as specified in the forest plan. Vegetative prescriptions would manage for uneven-aged forest stand conditions for live trees and retain live reserve trees, snags, down logs, and woody debris levels throughout woodland, ponderosa pine, mixed conifer, and spruce/fir forest cover types.

In addition, silviculture prescriptions would manage for old age trees such that as much old forest structure as possible is sustained over time across the landscape. Prescribed fire would likely burn with a variety of intensities across the landscape and may create some open pockets, depending on the amount of fuel available. In the long term, the combination of vegetative treatments and prescribed fire would result in a mosaic of vegetation densities (overstory and understory), age classes and species composition across the landscape, and increased understory vegetation, which are all beneficial to northern goshawks and prey species.

Under alternative 2, vegetation and fuels treatments would increase available early structure as well as open canopy moderate-aged and mature forest stands, while reducing amounts of dense moderate-aged and mature forest structure for all forest types considered (table 25). Mature stands with 40 to 60 percent canopy cover described as optimal goshawk foraging habitat by Reynolds and others (1992) would increase slightly overall. Proposed treatments would be expected to maintain adequate amounts of habitat to maintain most prey species and result in increases of prey associated with open mature stands such as cottontails and golden-mantled ground squirrels but reductions in dense moderate-aged and mature habitats may limit red squirrel availability as a prey source. Treatments would likely to benefit both goshawk and prey species overall by reducing the risk of overstory canopy loss due to stand-replacement fire.

**Table 25. Goshawk habitat size class amounts (acres), existing condition and post-treatment, alternative 2**

| VSS Class | Existing Condition | Alternative 2 Post-treatment | Change |
|---|---|---|---|
| 1 | 138 | 112 | +59 |
| 2 | 40 | 0 | -40 |
| 3 | 1,732 | 626 | -1,109 |
| 4 | 2,813 | 3,425 | +612 |
| 5 | 1,210 | 1,900 | +690 |
| 6 | 749 | 951 | +202 |

Proposed treatments under alternative 2 would reduce basal area and canopy cover values to below those prescribed as meeting nesting requirements (Reynolds et al. 1992) on approximately 779 acres (75 percent) of existing nest stands, thereby potentially limiting goshawk nesting opportunities within the project area. Stand density reductions within proposed fuelbreak units are expected to benefit goshawk habitat overall by reducing the potential for stand-replacement fire inside and outside the project area.

Nesting goshawks currently utilizing the project area should not be negatively affected as treatment areas would be surveyed prior to implementation and management guidelines would be followed to avoid any negative effects to breeding or breeding habitat.

Up to 5 miles of new system road would be created under this alternative; however, potential disturbance would be short term as this road would be closed after treatment. Use of temporary roads could also increase disturbance during project implementation if goshawks are nearby during the nesting season. However, the risk of disturbance would be low because suitable habitats would be surveyed for goshawks prior to implementation, and areas around nest sites would be restricted by a limited operating period. Decommissioning 13 miles of closed roads would limit illegal motorized trespass and provide an indirect benefit by reducing potential disturbance.

Other proposed activities under alternative 2, including restoration treatments, road management, and range improvements, would be expected to have minimal impacts on existing northern goshawk. If goshawks are determined present within the project area, project design criteria would apply to minimize risk of disturbance and impacts to habitat.

### Cumulative Effects

Past, present, and reasonably foreseeable activities that overlap in time and space with the treatment areas could have a cumulative effect on the northern goshawk and its habitat. As a species with specific nesting and roosting requirements but more flexible foraging habitat, areas outside protected and restricted habitat were considered. These activities are grazing, recreation, and historical timber management and prescribed fire projects.

The project boundary has historically been grazed for several hundred years. Currently, the Capulin, Fernandez, East Fernandez, and Tienditas allotments are active within the Pueblo Ridge cumulative effects analysis area. Herbaceous areas (including grasslands) and riparian habitats has been affected by historical and ongoing grazing activities on Federal lands and private lands.

Heavy grazing in the past before grazing management by Forest Service staff likely altered plant species composition and reduced the amount of riparian habitat available. Historical grazing had a

negative effect on goshawks due to the loss of prey species, changes to timber stands structures and removal of fuels for natural wildfires. Currently, grazing is actively managed and some site-specific riparian areas or prey habitat with herbaceous cover could still be negatively impacted. Additional sunlight from tree removal and prescribed fire would encourage the growth of ground cover which is often used as forage for cattle and as forage and cover for prey species. In addition, ground cover may be disturbed within the treatment areas during implementation activities due to machinery which may cause an additional disturbance to habitat utilized by prey species. The lack of suitable ground cover height may cause a temporary displacement of prey individuals, but these individuals would likely move to adjacent, undisturbed habitats and return once the area is rested from grazing and vegetation recovers from project activities.

It is reasonable to assume recreational activities (such as camping, hiking, horseback riding, and hunting, among others) have occurred in the past and would continually occur within treatment areas during project implementation. There could be an additive effect of noise and human presence, but this disturbance would likely be short term because project and recreation activities would not occur without interruption for extended periods of time. If goshawk or prey individuals are present, they would likely relocate to adjacent, undisturbed habitat and return when recreation and project activities cease.

Timber stands adjacent to treatment areas containing suitable goshawk habitat have been altered by previous and current timber, fuelwood, and prescribed fire projects. These projects are listed in appendix B. Districtwide dead and down permits and latilla permits may also change stand composition and the amount of down logs that contributes to goshawk and prey species habitat. These combined activities likely opened the canopy and increased grass and shrub availability to owl prey species. The improved stand condition and forest health resulting from these treatments likely has a cumulative benefit to the owl, unless excessive down wood is harvested or many large, mature trees are poached within designated fuelwood units. In addition, these treatments contribute to an overall improved resiliency to wildfires and pest and pathogens across the landscape that could potentially destroy habitat for this species.

The combination of grazing, recreation, and other activities may have an incremental effect on northern goshawks by potentially displacing foraging individuals or prey species and reducing potential habitat for prey. However, goshawk ability to conduct life-history behaviors would not be adversely impacted, so cumulative effects are considered minimal.

**Determination, Alternatives 1 and 2**

Due to the limited temporary negative effects on habitat or individuals and the likelihood of improved habitat quality after implementation activities, alternatives 1 and 2 may affect individuals but are not likely to result in a trend toward listing or a loss of viability for the northern goshawk.

## 2.5.6 Management Indicator Species

Both alternatives 1 and 2 would not affect forestwide habitat or population trends of any of the 11 management indicator species identified in the Carson forest plan. For more information and individual species descriptions, refer to the “Wildlife” report, which is included in the project record.

## 2.5.7 Migratory Birds

Project activities would not have a measurable negative affect on migratory bird populations. Although some temporary disturbance is anticipated, improving the overall health and resiliency of

the Carson National Forest would likely benefit migratory birds over the long term within the project area. For more information and individual species descriptions, refer to the "Wildlife" report, which is included in the project record.

## 2.5.8 Environmental Consequences Summary

### 2.5.8.1 Resource Indicators

Four resource indicators were selected for this project to analyze and disclose potential project effects on wildlife and suitable habitat (table 14). Although not all of these indicators were used for every species analyzed within this document, a general summary of the effects for each alternative is provided in table 26.

### 2.5.8.2 Determination Summary

A list of all effects determinations for threatened and endangered species and Southwestern Region sensitive species are displayed in table 17. For management indicator species (Brewer's sparrow (*Spizella breweri*), plain (juniper) titmouse (*Baeolophus ridgwai*), white-tailed ptarmigan (*Lagopus leucurcus*), hairy woodpecker (*Picoides villosus*), wild turkey (*Meleagris gallopavo*), Rocky mountain bighorn sheep (*Ovis canadensis canadensis*), Abert's squirrel (*Sciurus aberti*), red squirrel (*Tamiasciurus hudsonicus*), Rocky Mountain elk (*Cervis elaphus nelsoni*), resident trout and aquatic macroinvertebrates, the effects determinations for both alternatives 1 and 2 are "would not affect forestwide habitat and population trends".

**Table 26. Effects summary for resource indicators utilized within this analysis and compared between alternatives.**

| Resource Indicator | Measure | Effects under Alternative 1 | Effects under Alternative 2 |
|---|---|---|---|
| Cover and habitat type or keystone habitat feature (suitable habitat) | Acres or miles | Up to 9,709 acres treated and 3.4 miles of perennial streamside habitat and 10.5 miles of overall riparian habitat potentially affected.<br>Forested habitat would benefit from increased tree growth and vigor.<br>Forest health and resiliency to uncharacteristic events would likely improve.<br>Ecosystem function would likely improve.<br>Overall quality of suitable habitat would likely improve over time for most terrestrial and aquatic species with application on of project design criteria and best management practices described in the environmental assessment. | Up to 9,709 acres treated and 3.4 miles of perennial streamside habitat and 10.5 miles of overall riparian habitat potentially affected.<br>Forested habitat would benefit from increased tree growth and vigor.<br>Forest health and resiliency to uncharacteristic events would likely improve.<br>Ecosystem function would likely improve.<br>Overall quality of suitable habitat would likely improve over time for most terrestrial and aquatic species with application on of project design criteria and best management practices described in the environmental assessment. |

| Resource Indicator | Measure | Effects under Alternative 1 | Effects under Alternative 2 |
|---|---|---|---|
| Forest structure – diameter distribution | Vegetation structural stage (VSS) | Stands would move towards a more desired vegetation structural stage class.<br>Large tree distribution would be promoted and would likely improve habitat quality for most species.<br>VSS1: 725 acres<br>VSS2: 48 acres<br>VSS3: 664 acres<br>VSS4: 3,570 acres<br>VSS5: 3,548acres<br>VSS6: 1,154 acres | Stands would move towards a more desired vegetation structural stage class.<br>Large tree distribution would be promoted and would likely improve habitat quality for most species.<br>VSS1: 501 acres<br>VSS2: 55 acres<br>VSS3 : 918 acres<br>VSS4: 3,698 acres<br>VSS5: 3,586 acres<br>VSS6: 951 acres |
| Forest structure – stand density | Basal area per acre ($ft^2$ per acre) or trees per acre | Basal area and trees per acre would be reduced in treatment areas and would move closer to sustainable condition ranges.<br>Reduced basal area and trees per acre would improve habitat quality for a number of species by increasing remaining tree vigor and health.<br>Reduced fuel availability to promote uncharacteristic, stand-replacing events. | Basal area and trees per acre would be reduced in treatment areas and would move closer to sustainable condition ranges.<br>Reduced basal area and trees per acre would improve habitat quality for a number of species by increasing remaining tree vigor and health.<br>Reduced fuel availability to promote uncharacteristic, stand-replacing events. |
| Old growth allocation | Acres present after allocation | Twenty percent of acres within the piñon/juniper, ponderosa pine, mixed conifer, and spruce and spruce/fir habitats (total 2,284 acres) will be allocated for old growth.<br>Large trees will be maintained (larger vegetation structural stage 4 and above); habitat quality may improve for a variety of species by promoting the persistence and health of an older and mature age class of trees. | Twenty percent of acres within the piñon/juniper, ponderosa pine, mixed conifer, and spruce and spruce/fir habitats (total 2,284 acres) will be allocated for old growth.<br>Large trees will be maintained (larger vegetation structural stage 4 and above); habitat quality may improve for a variety of species by promoting the persistence and health of an older and mature age class of trees. |

# 2.6 Watershed

## 2.6.1 Introduction

This section examines potential effects to watershed resources from the removal of forest products within the Pueblo Ridge Restoration project boundary. Existing watershed data has been analyzed for the project. The proposed action proposes harvest of live and dead vegetation for wildfire fuels treatment on the Carson National Forest. Interpretations of soil properties and stream information provide a baseline risk assessment for hydrology and soil resources from proposed treatments.

## 2.6.2 Topics and Issues Addressed in This Analysis

### 2.6.2.1 Issues

The main issues that need to be addressed for soils and hydrology during project implementation and post-project are:

- limiting detrimental soil conditions and maintaining or improving levels of soil organic matter[28] such as the layer of pine needles, leaves, bark and other wood debris that cover the soil surface;
- maintaining water quality in area streams;
- protecting springs, seeps, and other water features; and
- protecting channels and riparian areas in the project area.

Issues include concerns about timber harvest techniques and ground disturbance, pile burn impacts, and landslide risk. For implementation of this project, ground-based equipment would be used. When large burn piles composed of large-diameter material are burned, the soil under them could be sterilized. For landslide risk, the project is located on steep terrain that could be at risk of landslides, and removal of vegetation could cause mass slope failure under certain conditions. The intent would be to implement the project in a way that would not destabilize the slopes while still reducing the fire hazard.

Hydrology concerns are impacts to water quality (typically from sedimentation) and the potential for increased water quantity resulting from removal of vegetation. Areas with more potential for sediment delivery to channels are places where roads cross streams and disturbance around springs and wet areas.

Soil concerns from timber sales include soil stability determined by evaluating compaction, displacement, and erosion from heavy equipment associated with logging, loss of soil organic matter and soil nutrients[29] as a result of vegetation removal, and increased risk of mass movement from changes in site stability and moisture content. Temporary road construction and use may lead to short- and long-term increases in soil compaction and erosion and decreases in soil productivity in the absence of proper reclamation. These concerns frame the template for indicators that serve as the focus of this analysis and design features to minimize the impacts to soil resources of the project area.

Indicators used to assess the potential effects of the alternatives are shown in table 27. The temporal boundaries for analyzing the direct and indirect effects for hydrology are years to decades, because effects can persist that long. Temporal boundaries for soils are decades to centuries, because changes in soils and soil recovery often occur at very slow rates.

[28] Soil organic matter is the fraction of the soil that consists of plant or animal tissue in various stages of breakdown (decomposition).

[29] Elements found in the soil needed for plant growth.

**Table 27. Resource indicators and measures for assessing effects**

| Resource Element | Resource Indicator | Measure (Quantify if possible) | Used to address: P/N, or key issue? | Source (Forest Plan S/G; Law or Policy, BMPs, etc.)? |
|---|---|---|---|---|
| Water quality | Sediment delivery | Number of road stream crossings | Yes | Forest plan |
| Water quality | Best management practices applied | Are best management practices applied to project | Yes | Forest plan requires best management practices for protection of springs and wet areas |
| Riparian function, and channel stability | Streamside cover, and channels | Road crossings in riparian corridors (miles) | Yes | Forest plan standard, Riparian 3 |
| Soil stability | Soil erosion, compaction and displacement, landslides | Hillslope sediment modeling | Yes | Forest plan standards, Watershed 1 and 2 |

P/N = purpose and need; S/G = standard or guideline, BMPs = best management practices

### 2.6.2.2 Water Quality

Direct effects to water quality would occur if sediment from road maintenance and construction is deposited directly into flowing stream channels. This effect would be instantaneous or nearly so. Direct effects to water quality would also occur if runoff from road surfaces and hillslopes carries sediment into flowing streams, which is most likely to occur at stream crossings and where road runoff enters a stream without flowing through buffer areas. Effects would occur from minutes to hours, depending on the intensity and duration of the storm or snowmelt rate.

These effects may occur until a road is effectively disconnected from a stream. Direct effects of hillslope treatments would occur if sediment is transported in runoff from eroding skid trails, landings, or from areas of high-severity prescribed fire that removes all ground cover.

Indirect effects to water quality would occur when sediment in runoff from road surfaces enters nonflowing tributary channels and is later carried into flowing streams during a runoff event. Indirect effects would occur if road and hillslope sediment is transported downstream of the project area and impairs beneficial uses. This could occur in a matter of minutes to hours, depending on the intensity and duration of a runoff event. Indirect effects to water quality would occur if sediment from temporary roads and hillslope treatments continues to be delivered to streams for more than 10 years after the project and perhaps longer if road surfaces and other soil disturbances are not effectively rehabilitated after the project.

Cumulative effects would occur if road and hillslope sediment is transported downstream of the project and adds to the sediment load from other activities in the area, which together impairs beneficial uses. This could occur in a matter of minutes to hours, depending on the intensity and duration of a runoff event. Cumulative effects to water quality would occur if sediment from temporary roads and hillslope treatments continues to be delivered to streams more than 10 years after the project and perhaps longer if road surfaces and other soil disturbances are not effectively rehabilitated after the project and add to the sediment load from other activities in the area, which together impair beneficial uses. Cumulative effects to sediment derived from hillslopes due to vegetation treatments would be reduced if treatments reduce the fire-severity level from high to moderate. Based on modeling, this effect would occur over the course of decades.

### 2.6.2.3 Riparian Condition

Direct effects to bank cover, sediment, floodplains, and overall riparian condition would occur from months to years if substantial changes in runoff and sediment quantities from roads and hillslopes enter into streams. Direct effects to shade, riparian woody vegetation, and crown cover would occur along stream course where roads cross streams or if treatments were implemented in stream management zones and resulted in the alteration of understory and overstory vegetation. Direct effects would include the destruction or modification of wetlands and floodplains in the short term (days to months) and would continue over the longer term (years) if causes are not addressed.

If substantial changes in runoff and sediment quantities from roads and hillslopes enter into streams and cause changes upstream or downstream, indirect effects to bank cover, sediment, floodplains, and overall riparian condition would occur from months to years. If substantial changes in runoff and sediment quantities from treated areas are increased and cause increased streamflow energies that would erode streambed and banks, cumulative effects to bank cover, floodplains, and overall riparian condition would occur from months to years. These effects would be added to the existing condition of active gullying and would be more likely to affect riparian areas and streams that are not properly functioning.

### 2.6.2.4 Soil Condition

Direct effects to soil function from compaction, displacement, and loss of organic matter would occur instantaneously in logging units during road and landing construction. If a large precipitation event occurs before erosion control measures are applied, direct effects from erosion would occur from days to weeks. Direct effects from burning include potential loss of ground cover and impacts to nutrient cycling when organic matter is burned. These effects would be instantaneous and may persist for several years, depending on burn severity. These effects would be minimized by use of best management practices.

Indirect effects to soil function from compaction, displacement, and loss of organic matter would occur from weeks to years due to road construction and also depending on the extent of skid trails and number of passes from skidders and other heavy equipment. Indirect effects to soil stability from burning include soil loss from erosion. Indirect effects to nutrient cycling from consumption of organic matter may persist for several years, until ground cover is reestablished. These effects would vary in space and time across the landscape and be minimized by use of best management practices.

Cumulative effects to soil function from compaction, displacement, and loss of organic matter would occur for years, when ground-disturbing activities and fire are combined with the extent of existing roads and trails and other past, present, and reasonably foreseeable projects. These effects generally last from months to years to decades, depending on the soil type and extent of disturbance. These effects would be minimized by use of best management practices.

### 2.6.2.5 Cumulative Effects Boundaries

The spatial boundaries for analyzing the cumulative effects to hydrology are the two mainly forested subwatersheds in which the project occurs: Headwaters Rio Fernando de Taos and Outlet Rio Fernando de Taos. For soils, the project units provide the unit boundaries.

The temporal boundaries for analyzing the cumulative effects are a few years to decades because effects can persist that long. Temporal boundaries for soils are decades to centuries because changes in soils often occur at very slow rates.

## 2.6.3 Affected Environment

### 2.6.3.1 Existing Condition

Watershed resources in the project area are located primarily in two forested subwatersheds with several perennial streams, including the Rio Fernando de Taos, and a network of intermittent and ephemeral channels with associated riparian areas. Runoff is due to spring snowmelt and summer rainstorms. See the "Watershed" report in the project record for additional details.

A number of springs occur in the project area. Most are undeveloped and several were observed to be heavily trampled. Soils in the watersheds vary with regards to erosion risk. Predominantly the roads network poses the highest risk for increased sedimentation in project watersheds, especially where roads cross stream channels. Several roads have been rehabilitated in the watersheds. Streams that are water-quality limited include the Rio Fernando de Taos on the southern border of the project area, which is listed for *E. coli* bacteria. Overall existing watershed conditions are rated functioning at risk due to a variety of factors.

**Table 28. Project area features**

| Feature | Unit of Measure |
|---|---|
| Project area without private lands | 9,709 acres |
| Project area without private lands | 15.2 square miles |
| Watersheds | Headwaters and Outlet Rio Fernando de Taos Watersheds |
| Wetlands | Acres |
| Freshwater emergent wetland total (riparian areas) | 2.67 |
| Freshwater forested/shrub wetland total (riparian areas) | 0.33 |
| Springs | 9 |
| Perennial streams | 25.7 |
| Road stream crossings (all streams) | 17 |
| Roads along streams (miles) | 7.5 |
| Open roads in project area | 6.0 |
| Closed roads in project area | 38.8 |
| User-created roads in project area | 3.2 |
| Roads grand total (miles) | 47.9 |

Erosion hazard on project area soils varies from slight to severe (table 29 and figure 16). Soils on higher-percent slopes are typically at risk of sheet and rill erosion. Mass failure risks exist in the project area typically in the form of debris flows in channels. Some of the project acres have not been surveyed for erosion risk, so total terrestrial ecosystem unit inventory acres are less than the project area. Resource indicators and measures for the existing conditions are shown in table 30.

**Table 29. Sheet and rill erosion hazard for project soils**

| Terrestrial Ecosystem Unit Inventory Map Unit | Erosion Hazard Rating | GIS Acres |
|---|---|---|
| 140 | Slight | 1,526 |
| 145 | Moderate | 58 |
| 159 | Severe | 161 |
| 390 | Slight | 274 |
| 816 | Severe | 3,711 |
| 817 | Severe | 2,599 |
| 819 | Severe | 491 |
| 820 | Severe | 97 |
| No survey | NA | 792 |

### 2.6.3.2 Water Quality

Road networks can be serious threats to water quality. Potential impacts from roads include surface erosion and delivery of generated sediment directly or indirectly to the stream system. Most of the impacts to water quality from unsurfaced roads are a result of short-duration, high-intensity rainstorms causing particle detachment, transport, and delivery to the channel. Without proper drainage, and an adequate buffer strip, the risk of sediment delivery to the stream channel increases substantially. Sediment sources in project watersheds are primarily from National Forest System road networks, especially where roads cross surface drainages. The number of road-stream crossings on currently used National Forest System roads are used as an indicator of sediment delivery to streams.

The Water Erosion Prediction Project sediment model was developed for the U.S. Forest Service for evaluating sediment that may be created from various ground disturbing activities associated with fuels reduction and other impacts. Sediment from road development and construction and impacts of fuels reduction on soils are typically evaluated. The model basically looks at intensity of disturbance and the physical conditions of the area involved to provide an estimate for sediment yield from the project. The model estimates are done to provide a project impact before best management practices are applied. Best management practices applied to the project activities would substantially reduce predicted sediment.

Sediment delivery at stream crossings has been estimated for this project using Water Erosion Prediction Project (WEPP) model estimates of project effects and conditions without any best management practices being applied. Best management practices are required for road maintenance, construction, or decommissioning efforts; fuels reduction efforts; and other ground disturbing activities. Project effects would be reduced using best management practices. Once best management practices are applied for stream crossings or other impacts, sediment generated at crossings would be reduced substantially.

The Rio Fernando is a 303(d) water-quality-limited stream in the project area. It is listed for *E. coli* bacteria. This project is not likely to affect the concentration of *E. coli* in surface waters. As a result, *E. coli* concentration will not be used as an indicator for water quality.

It is the responsibility of the Forest Service as a Federal land management agency through implementation of the Clean Water Act, to protect and restore the quality of public waters under its jurisdiction. Best management practices in the form of design features are used to meet water quality standards (or water quality goals and objectives) under section 319, and application of these is a critical indicator for maintaining and improving water quality.

Forest Service Manual 2532 provides policy and direction specific to water quality management on National Forest System lands. The objective of water quality management on National Forest System lands is to protect and, where needed, improve the physical, chemical, biological, and aesthetic quality of the water resource consistent with the purposes of the national forests and national water quality goals. Best management practices applied should be based on site-specific conditions and political, social, economic, and technical feasibility. Compliance with approved best management practices for the control of nonpoint sources should constitute compliance with water quality standards, and methods that reflect nonpoint source conditions should be used to measure effectiveness of those best management practices.

#### 2.6.3.3 Riparian Function

Several streams in the project area have riparian vegetation along the stream corridor. In many cases, such as Capulin Creek and smaller drainages such as Cortado Canyon and Ranchos Canyon, the vegetation is isolated in a relatively narrow band along the channels. In other areas, such as along the Rio Fernando, riparian vegetation can extend out from the stream over 50 to 100 feet. Riparian species can include willows, sedges and rushes, cottonwoods, and ash. These species play a significant role in protecting streambanks and providing a local source of shade for channels, which helps moderate stream temperatures.

Overstory conifer species along riparian areas have been observed along project area channels. Large conifers can have a suppressive effect on the growth and recruitment of near-stream riparian obligate vegetation, such as willows and cottonwoods. Riparian species play a significant role in providing channel stability by strengthening streambanks with dense root masses. Suppressing riparian species can lead to bank instability through loss of root strength, which in turn can lead to over-widened channels and increased downstream sedimentation.

Riparian function and channel stability can be impacted by fuels reduction activities. The extent of existing and proposed new road crossings of streams in riparian corridors can be a useful indicator of impacts to riparian areas that can impact stream channel stability.

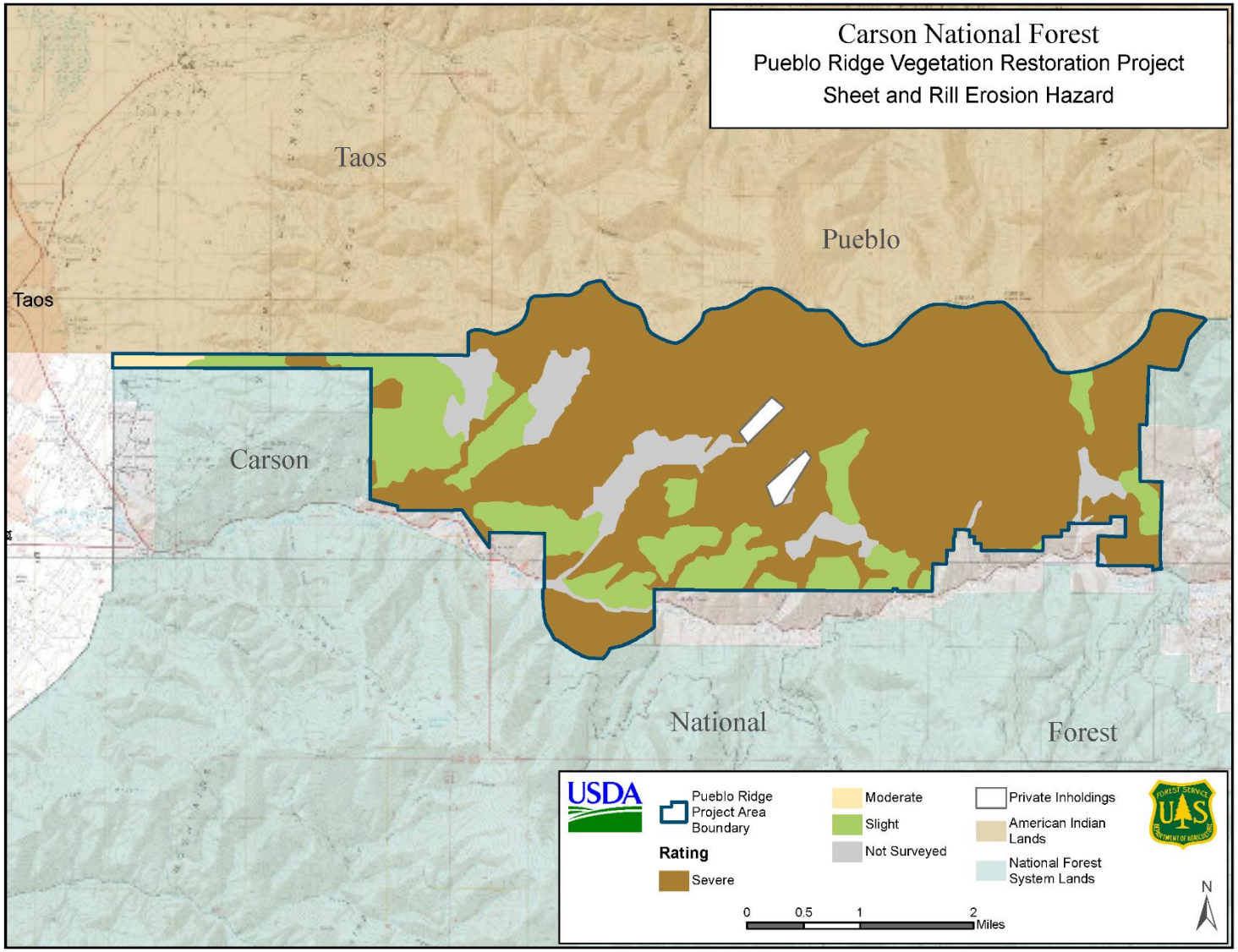


**Figure 16. Sheet and rill erosion hazard for the project area**

**Table 30. Resource indicators and measures for the existing condition**

| Resource Element | Resource Indicator | Measure (Quantify if possible) | Existing Condition | Alternative 1 | Alternative 2 |
|---|---|---|---|---|---|
| Water quality | Sediment delivery | Number of road stream crossings | 13 | 1 (0.25 tons sediment annually). This result was estimated using current conditions without best management practices would be applied to reduce sediment generated at crossings. | 4 new road stream crossings- one ton additional sediment predicted by modeling. Best management practices would be applied to reduce sediment generated at crossings. |
| Water quality | Best management practices applied | Are best management practices applied to project? | Currently best management practices are applied | Best management practices would be applied | Currently best management practices are applied |
| Riparian function | Changes in streamside cover along channels | Existing road stream crossings in riparian corridors (number) | 13 | 1 new road stream crossing would locally impact stream and riparian area | Four new stream crossings would locally impact streams and riparian areas. |
| Soil stability | Soil erosion | Acres treated on terrestrial ecological units with severe erosion hazard (soil stability), WEPP modeling results | Pre-project- No sediment generated from project area units. Sediment generated from project area open roads | No sediment generated off-site from project area units. Sediment generated from project area roads, skid trails | No sediment generated off-site from project area units. Sediment generated from project area roads, skid trails |

WEPP = Water Erosion Prediction Project

#### 2.6.3.4 Soil Stability

Soils have been assessed for this report using data from the terrestrial ecosystem surveys of the Carson National Forest (USDA Forest Service 1987). The terrestrial ecosystem unit inventory is the basis for interpreting soil characteristics, vegetation and landforms. Ecological land units are assigned a soil condition category, which is an indication of the status of soil functions (hydrology, stability and nutrient cycling). Hydrologic indicators assess the ability of a soil to absorb, store, and transmit water; stability refers to the ability of a soil to resist erosion; and nutrient cycling is based on organic matter (vegetation, litter, coarse woody material, and root distribution) characteristics. Three categories of soil conditions are recognized: satisfactory, impaired, and unsatisfactory (USDA Forest Service 1999). Satisfactory indicators signify soil function is being sustained and soil is functioning properly and normally. Impaired indicators signify a reduction of soil function.

Soil erosion occurs naturally but can be accelerated by management activities or natural disturbance agents that reduce or remove vegetative ground cover, canopy cover, or both. Sediment has been modelled from roads, from undisturbed sites, and from treated areas (Water Erosion Prediction Project version 2010.100). Other site factors influencing erosion rates include the presence and amount of rock fragments, the susceptibility of the surface soil to erosion, and local topography.

For highly sensitive soil, the ability of a soil to function properly has been reduced, there is an increased vulnerability to degradation, or both. Unsatisfactory indicators signify loss of soil function has occurred. Degradation of vital soil functions result in the inability of soil to maintain resource values, sustain outputs, and recover from impacts. Extent and location of soils with severe limitations for erosion hazard are a suitable indicator for erosion risk in the project area.

### 2.6.4 Environmental Consequences

Differences between action alternatives used to determine watershed effects are highlighted in table 30. Only areas with slopes equal or less than 40 percent would be treated with ground-based equipment under alternative 2. The extent of areas with severe erosion hazard are high for both alternatives. Virtually all steep slope areas proposed for mechanical treatment have soils with a high erosion hazard.

#### 2.6.4.1 Alternative 1

Resource indicators and measures for alternative 1 are shown in table 30.

##### *Direct and Indirect Effects*

The direct effects of the proposed action (alternative 1) would be the removal of forest products from 9,709 acres, including development of skid trails, landings, and temporary roads. Within this total land area, soil erosion hazard is severe on 7,068 acres. Soils with severe soil erosion hazard have a high potential for increased erosion rates from ground disturbance. This alternative complies with the Carson forest plan (with amendments) and meets the project purpose and need.

Water Erosion Prediction Project modeling indicates no sediment runoff is expected from harvest units, even on steeper slopes. Skid trail networks and roads would be sources of sediment, especially in steeper areas, but best management practices would substantially reduce sediment produced by skid trail networks and roads.

The current level of livestock- and wildlife-induced streambank instability would continue to add sediment to streams. Camino Real Ranger District personnel monitor livestock grazing and periodically adjust management practices to meet multiple resource objectives. Recreational off-road vehicle use of existing roads would continue to occur. Impacts would include compaction, displacement, rutting, and erosion of forest soils.

Nine springs would be developed under this alternative. This would involve fencing water sources and routing water away from spring source areas in to a trough or other structure. The four spring developments of alternative 2 would provide critical watering needs for permitted livestock in a way that would allow adequate animal distribution across the landscape and away from sensitive areas, such as wetlands and riparian areas. The nine spring developments of alternative 1 may provide supplemental watering opportunities beyond what is considered critical and would result in the development of springs that may be considered properly functioning in their natural state. However, unless the spring outlets are fenced, protection of springs in an active grazing allotment is not guaranteed. Under either alternative, developed springs would be fenced with wildlife-friendly fencing, and water would be piped to drinkers outside of fenced areas in order to inhibit trampling and livestock concentration at spring outlets. Because nine springs would be developed under alternative 1, and only four for alternative 2, alternative 1 would fence out more spring outlets, preserving them in an untrampled state, with benefits to water quality at these sites, as long as fences and spring development infrastructure are continually maintained over the long term. Maintenance of this infrastructure would be administered through a special use permit.

The proposed action would require the construction of an additional 5 miles of temporary road. After harvest, 13 miles of system road would be decommissioned. Depending on the method used to decommission roads, recovery of soil hydrology, stability, and nutrient cycling would occur over time.

Temporary roads would have the potential to route water and sediment from the road surfaces. Sediment modeling indicates a potential increase in road-generated sediment from project roads, most likely in the form of suspended and dissolved particles. Streamside management zones and other best management practices would reduce or eliminate the direct effect of roads and proposed treatments to riparian-wetland areas and stream-riparian areas. Soil and water conservation best management practices, such as cross drains, water bars, and dips, would reduce the direct effect of road surface runoff.

Modeling indicates any erosion from hillslope treatments would be retained on hillslopes or by stream management zone buffer areas, with no direct effects to water quality. Vegetation treatments are not designed to increase water yield; therefore, long-term changes to stream channel morphology from increased runoff are not expected to occur. Changes to floodplain and wetland function would be avoided through streamside management zones and other best management practices designed to reduce hillslope runoff and sedimentation rates.

### Roads

Construction of temporary roads would minimize disturbance to soils, vegetation, and root structure. All temporary roads would be located on low to moderate gradient slopes mostly outside of streamside management zones. Road maintenance on 44 miles of road would improve road drainage under this alternative.

All temporary and other roads would have the potential to route water and sediment from the road surfaces. Modeled road-related sediment would occur at a rate of 0.1 to 0.25 tons per year for each crossing. Actual sediment would be substantially reduced by the use of the design features and best management practices at the stream crossings. The use of these design features would substantially reduce the likelihood of sediment reaching waterways at stream crossings, given the established effectiveness of these best management practices in capturing and redirecting sediment that would otherwise affect downstream water quality. Because personal-use fuelwood removal would be controlled, random use of closed roads and off road travel would be reduced, which would allow road surfaces to revegetate.

Temporary roads would be constructed primarily on soils with slight to moderate erosion hazard. Due to location, slight limitations for unsurfaced road construction of the soils, slope gradient, and the use of best management practices, the potential for water and sediment reaching streams is low.

Construction of 5 miles of temporary roads would cause direct impacts in the form of compaction and displacement of soils on about 7 acres in the project area. Erosion potential is the greatest during and immediately after temporary construction. The one new temporary road-stream crossing would be at higher risk of contributing sediment during construction. Other than at the one stream crossing, the temporary road system would not occur within 200 feet of the existing drainage system, thereby minimizing the potential for road-related water and sediment to enter into the drainage network.

Water Erosion Prediction Project sediment modeling indicates a potential increase in the probability of all road-generated sediment, most likely in the form of suspended and dissolved particles, that would also be transported to lower reaches outside of the project area. Actual sediment produced by roads would be substantially reduced by best management practices and project design features. These conditions would be expected to last up to 10 years, until road beds are decommissioned and surfaces stabilized. Most water quality effects from the project would be from the indirect effect of sediment eroded from roads.

Skid trail networks within units would have the potential to indirectly generate runoff and sediment. Up to a quarter ton per acre of sediment could be generated from skid trails in steeper units based on Water Erosion Prediction Project sediment modeling. The modeling indicates any erosion from hillslope treatments would be retained on hillslopes or by stream management zone buffer areas. Modeled background hillslope erosion shows it would occur at a negligible rate after all hillslope treatments are completed, and road-generated sediment would return to pre-project levels after temporary roads are restored. The model also shows if the overall treatments are successful at reducing the wildfire effects from severe to moderate, an overall 37 percent to 58 percent reduction in sediment from project area watersheds may be realized during the long term.

Best management practices and design features, including operating on slash and placement of water bars on skid trails and landings, would directly reduce the direct effect of skid trail and road surface runoff by limiting the contributing area to approximately 100 to 300 feet or less, rather than from entire road or skid trail segments. With the use of best management practices, the total temporary road surface area contributing runoff and sediment would be less than one acre.

#### *Cumulative Effects*

Short-term soil compaction, displacement, and organic matter removal would occur during the course of the project, which may last up to 10 years. Additional impacts to watersheds could occur from ongoing, past, or future projects, such as livestock grazing, fuelwood collection, or other projects in the area. During this period, effects would be in addition to soil impacts due to livestock and wildlife grazing and trailing, mostly along riparian areas and meadows. Ongoing and future projects that may affect cumulative watershed effects in project watersheds are listed in appendix B. Hillslope erosion and sediment modeling suggests the combined effects of treatments would result in a reduction of background hillslope erosion, which would enhance soil productivity and overall soil condition for decades.

After 10 years, water quality in the subwatersheds would be expected to improve over the existing condition as a result of reducing the potential effects of wildfire from severe to moderate. Modeled background hillslope erosion would occur at a reduced rate after all hillslope treatments are completed, and road-generated sediment would return to pre-project levels after temporary roads are decommissioned.

The type, location, and distribution of proposed treatments are not designed or expected to increase water quantity. The project effects to water yield would be minimal. Other impacts in the watershed as a result of past, present, and reasonably foreseeable projects are not occurring on a scale large enough to impact water yields. Because direct and indirect effects to runoff would be relatively minor and immeasurable, and cumulative increases in water yield from other activities in the watershed from the project to water yield would not be measurable, little cumulative increase in water yields are expected in the project area as a result of the project.

### 2.6.4.2 Alternative 2

#### *Direct and Indirect Effects*

Short-term soil compaction, displacement, and organic matter removal would occur during the course of the project, which may last up to 10 years. During this time, effects would be in addition to soil impacts due to livestock and wildlife grazing and trailing, mostly along riparian areas and meadows. By reducing wildfire risk, hillslope erosion and sediment modeling suggest the combined effects of treatments would result in a reduction of background hillslope erosion which would enhance soil productivity and overall soil condition for decades. Modeling indicates any erosion from hillslope treatments would be retained on hillslopes or by stream management zone buffer areas, with little direct and indirect effects to water quality. Water Erosion Prediction Project modeling indicates no sediment runoff is expected from harvest units, even on steeper slopes. Skid trail networks and roads would be sources of sediment, especially in steeper areas, but project design features and best management practices would substantially reduce sediment produced by skid trail networks and roads.

As in alternative 1, the type, location, and distribution of proposed treatments are not designed or expected to increase water quantity. Other impacts in the watershed as a result of past, present, and reasonably foreseeable projects are not occurring on a scale large enough to impact water yields. Because direct and indirect effects to runoff would be relatively minor and immeasurable, and cumulative increases in water yield from other activities in the watershed from the project to water yield would not be measurable, little cumulative increase in water yields are expected in the project area as a result of the project.

For alternative 2, five miles of temporary road would be needed, and five miles of new system road would also be needed. New system roads would be located in some cases in steeper terrain than proposed temporary roads. Runoff from road surfaces would be mitigated by best management practices, such as cross drains, water bars, dips and vegetated buffers, which would limit runoff from road surfaces to small contributing areas (less than 1 acre) near stream crossings. As in alternative 1, all roads would have the potential to route water and sediment from the road surfaces. Sediment modeling indicates a potential increase in road-generated sediment from project roads, most likely in the form of suspended and dissolved particles. Streamside management zones and other best management practices would reduce or eliminate the direct effect of roads and proposed treatments to riparian-wetland areas and streams-riparian areas. Impacts of road construction in riparian areas at crossings would include a reduction in shade provided to the channel, locally disturbed stream banks, and disturbance of vegetation. Best management practices would be used to stabilize channels at the four stream crossings. Sediment generated from roads leading to these stream crossings is estimated to be about one ton, based on erosion modeling at a watershed scale with no best management practices in place.

Actual sediment from these crossings would be substantially reduced by the use of design features and best management practices at stream crossings. This would substantially reduce the likelihood of sediment reaching waterways at stream crossings, given the established effectiveness of these best management practices and design features in capturing and redirecting sediment that would otherwise affect downstream water quality.

The four spring developments of alternative 2 would provide critical watering needs for permitted livestock in a way that would allow for adequate animal distribution across the landscape and away from sensitive areas, such as wetlands and riparian areas. In contrast, the nine spring developments of alternative 1 may provide supplemental watering opportunities beyond what is considered critical, and would result in the development of springs that may be considered properly functioning in their natural state. There would be some benefit from the strategy of developing widely dispersed springs in alternative 2; however, unless the springs are fenced or developed, protection of springs in an active allotment is not guaranteed.

Modeling indicates any erosion from hillslope treatments would be retained on hillslopes or by stream management zone buffer areas, and treatments would result in overall beneficial indirect effects to water quality over time.

### *Cumulative Effects*

Short-term soil compaction, displacement, and organic matter removal would occur during the course of the project, which may last up to 10 years. During this period, these effects would be in addition to soil impacts due to livestock and wildlife grazing and trailing, mostly along riparian areas and meadows. Ongoing and future projects that may affect cumulative watershed effects in project waterhsheds are listed in appendix B. Hillslope erosion and sediment modeling suggests the combined effects of treatments once finalized would result in a reduction of background hillslope erosion, which would enhance soil productivity and overall soil condition for decades.

After 10 years, water quality in the subwatersheds would be expected to improve over the existing condition as a result of reducing the potential effects of wildfire from severe to moderate. Modeled background hillslope erosion would occur at a reduced rate after all hillslope treatments are completed, and road-generated sediment would return to pre-project levels after temporary roads are decommissioned.

The type, location, and distribution of proposed treatments are not designed or expected to increase water quantity. Because no direct or indirect effects to water quantity are expected, little cumulative increase to water quantity would occur from the proposed action.

# 2.7 Recreation

## 2.7.1 Topics and Issues Addressed in This Analysis

This section evaluates and documents the impacts on recreation of the proposed alternatives for the Pueblo Ridge Restoration Project. It provides sufficient analysis to determine the effects of the alternatives, and if the proposal and alternatives are in compliance with relevant laws, regulations, and policies.

**Table 31. Resource indicators and measures for assessing effects.**

| Resource Element | Resource Indicator | Measure (Quantify if possible) | Used to address: P/N, or key issue? | Source (Forest Plan S/G; law or policy, BMPs, etc.)? |
|---|---|---|---|---|
| Recreation opportunities | Loss of recreation opportunities or displacement of visitors due to project activities | Duration and timing of project activities | No | Carson forest plan standards and guidelines for recreation |
| Trails | Change in trail conditions due to project activities | Miles of trail | No | Best management practices for trails |
| Access for dispersed recreation | Change in access for dispersed recreation due to road decommissioning and closure | Miles of road decommissioning or closure | No | Carson forest plan standards and guidelines for recreation |
| Roads | Change in road conditions due to maintenance, reconstruction, or both | Miles of road maintained or reconstructed | No | Best management practices for roads |

P/N = purpose and need; S/G = standard or guideline; BMPs = best management practices

## 2.7.2 Affected Environment

### 2.7.2.1 Existing Condition

The Pueblo Ridge Restoration project area is located east of Taos, New Mexico. Highway 64 in Taos Canyon generally runs along the southern boundary of the project area, however, a small portion of the project area near La Sombra and Capulin Campgrounds extends south of the highway. This stretch of highway is part of the Enchanted Circle National Scenic Byway that offers scenic views and connects Taos and Questa with the resort communities of Red River, Eagle Nest, and Angel Fire. There are a variety of recreation opportunities available year-round within the project area. The primary recreation activities are hiking, mountain biking, horseback riding, camping, hunting, off-highway vehicle use, and scenic driving. Christmas tree cutting and fuelwood gathering are also popular activities within the project area. Winter activities include cross-country skiing and snowshoeing.

A national forest's recreation niche defines the best-suited recreation experiences or benefits the national forest can provide. The Carson's recreation niche, documented in the 2008 Carson National Forest recreation facility analysis, is:

> "To illustrate recreation and the traditional subsistence way of life working hand in hand. Area residents are tied to its past, from the 'ancients' through today. Many have an intimate connection with the resources that have sustained them for centuries. Trails and roads access the Carson for play and work purposes. Understanding these ties is critical to appreciating the Forest" (USDA Forest Service 2008).

Two campgrounds located in Taos Canyon provide developed camping opportunities within the project area. La Sombra Campground has 13 campsites, and Capulin Campground has 10 campsites. The Capulin Campground also features the Capulin Ice Caves Trail (109). This one-half-mile-long trail accesses an ice cave at the south end of Capulin Campground. Both campgrounds provide fishing access to the Rio Fernando de Taos. The campgrounds are typically open from Memorial Day through Labor Day weekend. Visitor use is highest during the month of July and on holiday weekends.

A portion of the nonmotorized North Boundary Trail (495) is within the western side of the project area. The trail connects to the Devisadero Loop Trail (108) outside the project area. Trail use is recommended in the summer and fall for hiking, biking, and horseback riding and in the winter and early spring for cross-country skiing and snowshoeing. The Capulin Trail (494) is a motorized trail within the central portion of the project area. In the summer and fall, the trail is open to hiking, mountain biking, and horseback riding and also open to motorcycles. When it is closed for the winter, it is a quiet place to cross-country ski or snowshoe.

Forest Service personnel use the recreation opportunity spectrum to inventory and describe the range of recreation opportunities available based on the physical (characteristics of the land and facilities), social (interactions and contact with others), and managerial (services and controls provided) characteristics of an area. The recreational settings are described on a continuum ranging from primitive to urban. The recreation opportunity spectrum classes within the Pueblo Ridge Restoration project area are roaded natural and semi-primitive motorized (see figure 17). Roaded natural areas are within a half mile of highways and heavily used dirt roads, the environment is predominately natural appearing, and there are opportunities for both motorized and nonmotorized recreation with low to moderate interaction between users. Semi-primitive motorized areas are within a half mile of lower standard National Forest System roads, the environment is predominantly natural appearing, and there are opportunities for motorized and nonmotorized dispersed recreation; access may require four-wheel drive or high-clearance, rugged vehicles. For a complete description of the recreation opportunity spectrum classes, please see the recreation standards and guidelines in the Carson forest plan (Recreation-2 and 3). The scenery within the project area has high public value (scenic classes 1 and 2), especially along major travel routes, such as Highway 64. Scenic views contribute to the use and enjoyment of the area.

The Taos Pueblo Blue Lake Wilderness area borders the project area to the north. On December 15, 1970, the Congress of the United States legally enacted Public Law 91-550, the Taos Pueblo Wilderness Act, which put the Blue Lake Wilderness area into trust status. This law provided the Tribe with exclusive use of the area for traditional purposes. This area is closed to the public and is specifically for use by members of the Taos Pueblo. Communities in Taos Canyon are adjacent to the project area on the south, and Taos Pueblo lands are located to the north.

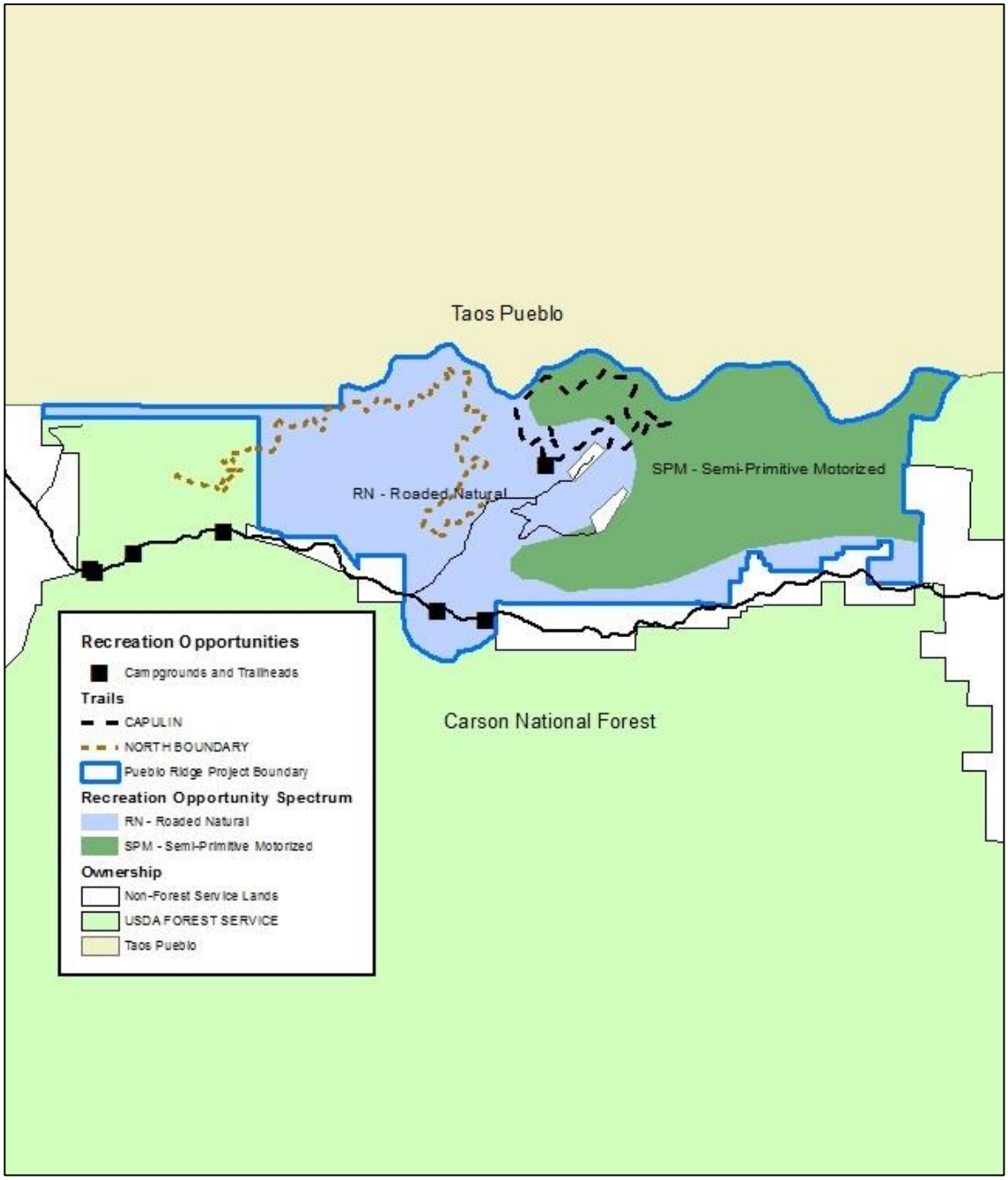


**Figure 17. Pueblo Ridge Restoration Project recreation opportunities**

## 2.7.3 Environmental Consequences

### 2.7.3.1 Alternative 1 – Proposed Action, Forest Plan Amendments

*Direct and Indirect Effects - Alternative 1*

**Recreation Opportunities**

The proposed vegetation and fuels treatments, restoration treatments, road management, and range improvement activities would be implemented and would directly affect recreation activities and experiences in the project area. Implementation of the project activities may require temporary road or trail closures or limited access to the immediate area to protect public safety. The recreation experience in the immediate vicinity of project implementation activities would be impacted by the sights and sounds of equipment including ground-based logging equipment, chainsaws, and truck traffic within the treatment units and log truck traffic on the haul routes. Visitors may choose to avoid the areas during project implementation activities. These effects would be temporary and short term.

Design features and best management practices would be followed for the protection of recreation resources and visitor safety, including coordination of project implementation timing to reduce impacts to recreation, especially during primary recreation seasons and in popular recreation areas; public notification of project activities and temporary area or trail closures; protection of campground and trail infrastructure; and for the prevention of unauthorized motorized use following project implementation.

The proposed vegetation and fuels treatments may indirectly affect the recreation setting within the project area by changing the scenic qualities within the treatment areas. The fuels reduction, thinning, and aspen restoration activities would reduce stand density, and the cut tree stumps would remain visible to visitors passing through the project area. The prescribed burning activities would create blackened areas on the landscape.

Other long-term benefits of the proposed action, including a more diverse and resilient forest ecosystem and reduction in the risk of negative impacts from severe wildfire, have the potential to indirectly benefit recreation by helping maintain the settings and opportunities currently valued by the public for recreation within the project area. Studies suggest less intense fires may have beneficial economic effects on outdoor recreation, whereas intense fires may have detrimental effects (Vaux et al. 1984).

Riparian restoration (conifer removal) treatments are proposed adjacent to the Rio Fernando de Taos in the La Sombra and Capulin Campgrounds. Mechanical vegetation treatment is proposed adjacent to and south of the campgrounds. Under alternative 1, mechanical treatment could occur on slopes greater than 40 percent, potentially increasing the presence of mechanical equipment within and adjacent to the campgrounds. There are design features in place that require consultation with the recreation specialist to identify trees to either leave or remove within developed recreation sites and timing considerations to limit impacts of project implementation on developed recreation and concession operations during the summer season.

Opportunities for dead and down fuelwood harvesting would be provided on up to 9,709 acres across the project area along designated temporary roads and potential off-road travel for specific fuelwood areas for up to 10 years following thinning activities. This would enhance fuelwood harvesting opportunities that are important for the residents of Taos and the surrounding communities.

### Trails

The nonmotorized North Boundary Trail (495) within the western portion of the project area and the motorized Capulin Trail (494) located within the central portion of the project area are proposed for use as haul routes. Haul routes would receive maintenance to bring them up to standards necessary for project implementation. The use of the trails as haul routes would temporarily change the trail experience due to route maintenance changing the physical appearance of the trail and due to the presence of motorized vehicles and equipment along the trail during project implementation. For trails within or along the boundary of treatment units or trails used as haul routes, there are design features to ensure the trail route is clearly marked and maintained, and hazard trees along the trail are removed. If treatment operations cross or damage the trail tread, the trail would be reestablished to the appropriate design standards when implementation is complete. The portion of Trail 495 that would be used as a haul route is currently a two-track roadbed already used by permittees with motorized vehicles.

### Access for Dispersed Recreation and Roads

Road maintenance would occur on approximately five miles of roads currently open to the public. Proper construction and maintenance of roads and trails within the project area would provide long-term benefits by providing access to dispersed recreation, and reducing maintenance costs over time.

Decommissioning and closing 13 miles of road would be included to reduce erosion from current road conditions. The roads proposed for decommissioning, closure, or both do not include roads needed for grazing or other permittee access, fire suppression, or administrative access for Carson National Forest management. The roads proposed for decommissioning are not currently open to the public, and are not shown on the motor vehicle use map. The proposed road decommissioning would not impact existing opportunities for motorized recreational use or access.

Fire lines, skid trails left by ground-based harvest and removal methods, and temporary roads may open unauthorized access for off-highway vehicles to areas where vegetation had kept them out. To reduce the likelihood of unauthorized motorized use, design features are in place to minimize the appearance of skid trails where they intersect with existing roads and trails. In addition, up to five miles of temporary roads are proposed for construction to provide access for management activities. Temporary roads also increase the potential for illegal off-highway vehicle use. The temporary roads would be obliterated or decommissioned following project implementation to reduce the likelihood of illegal motorized use.

### *Cumulative Effects – Alternative 1*

**Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis**

Cumulative effects to recreation within the Pueblo Ridge Restoration project area would relate to other administrative or national forest management activities occurring within or immediately adjacent to the project area. Cumulative impacts would result if other activities take place during implementation of the Pueblo Ridge Restoration Project or until vegetation growth obscures the visible stumps from the vegetation treatment activities and prescribed fire, approximately 3 to 5 years.

Recreational activities such as hunting, camping, hiking, off-highway vehicle travel, and cross-country skiing in the winter will continue within the project area. Other ongoing and reasonably foreseeable activities that will be occurring within the analysis area are continued use of grazing allotments, maintenance of range improvements, ongoing uses and maintenance activities associated with special use permits such as power lines, and road use, road and trail maintenance, and fuelwood and Christmas tree cutting. All these activities, when added to the activities proposed in the Pueblo Ridge Restoration Project, have the potential to cumulatively affect the recreation experience within the project area. The primary impacts would be due to the increased presence of people, vehicles, and associated noise that would directly affect the ability of recreational visitors to enjoy their desired experience and could lead to the short-term displacement of visitors who choose to avoid the area during implementation of the various activities.

The obliteration of closed roads currently on the landscape would cumulatively add to other travel management implementation actions that could occur across the Camino Real Ranger District in accordance with the 2013 travel management decision.

## 2.7.3.2 Alternative 2 – Proposed Action, No Forest Plan Amendments

### *Direct and Indirect Effects - Alternative 2*

**Recreation Opportunities**

The direct and indirect effects on recreation opportunities from alternative 2 would be the same as those described in alternative 1, with the following exception: although mechanical vegetation treatment is proposed adjacent to La Sombra and Capulin Campgrounds in alternative 2, without the proposed forest plan amendments, mechanical treatment would not occur on slopes greater than 40 percent. The steep slopes to the south of the campground could still be treated using hand treatments, resulting in less presence of mechanical equipment within and adjacent to the campgrounds than may occur in alternative 1.

**Trails**

The direct and indirect effects on trails from alternative 2 would be the same as described in alternative 1.

**Access for Dispersed Recreation and Roads**

The direct and indirect effects on access for dispersed recreation and roads from alternative 2 would be the same as described in alternative 1, with the following exception: alternative 2 would provide an additional 5 miles of permanent road construction. This would add to the visual presence of a new road on the landscape and could increase the potential for illegal motorized use on this route following project completion.

### *Cumulative Effects – Alternative 2*

**Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis**

The cumulative effects of alternative 2 would be essentially the same as described in alternative 1.

## 2.7.3.3 Summary of Environmental Effects

### *Recreation Opportunities*

The potential effects to recreation from the proposed actions in both alternative 1 and 2 are very similar and would lead to short-term, temporary loss of recreation opportunities and potential displacement of visitors during project implementation.

**Table 32. Summary comparison of environmental effects to recreation resources**

| Resource Element | Resource Indicator or Measure | Alternative 1 | Alternative 2 |
|---|---|---|---|
| Recreation opportunities | Loss of recreation opportunities or displacement of visitors due to project activities. Duration and timing of project activities | Short-term, temporary loss of recreation opportunities and potential displacement of visitors during project implementation. Design features are in place to minimize impacts. | Short-term, temporary loss of recreation opportunities and potential displacement of visitors during project implementation. Design features are in place to minimize impacts. |
| Trails | Change in trail conditions due to project activities. Miles of trail | Approximately 5 miles of nonmotorized North Boundary Trail (of the 12.4 miles of the North Boundary Trail) and approximately 5 miles of motorized Capulin Trail upgraded to haul route for the duration of the project. | Approximately 5 miles of nonmotorized North Boundary Trail (of the 12.4 miles of the North Boundary Trail) and approximately 5 miles of motorized Capulin Trail upgraded to haul route for the duration of the project |
| Access for dispersed recreation | Change in access for dispersed recreation due to road decommissioning and closure. Miles of road decommissioning and closure | 13 miles of decommissioning (roads currently closed to the public); no change in access for dispersed recreation | 13 miles of decommissioning (roads currently closed to the public); no change in access for dispersed recreation |
| Roads | Change in road conditions due to maintenance, reconstruction, or both. Miles of road maintained or reconstructed | 5 miles of roads currently open to the public would be maintained. | 5 miles of roads currently open to the public would be maintained. 5 miles of new permanent road would be constructed but not available for public use. |

### *Trails*

The potential impacts to trails due to their use as haul routes would be the same for alternative 1 and 2. This would be a temporary impact during project implementation.

### *Access for Dispersed Recreation/Roads*

Decommissioning and closure of 13 miles of roads that are currently closed to the public would help accomplish implementation of the travel management decision for the Camino Real Ranger District and would reduce opportunities for illegal vehicle use on these routes. Road maintenance on five miles of roads currently open to the public would enhance road conditions and recreational access. The effects of road decommissioning and road maintenance would be the same for alternatives 1 and 2. The additional construction of five miles of new permanent road proposed in alternative 2 would add the visual presence of a new road on the landscape and the overall potential for illegal motorized use on this route.

# 2.8 Heritage Resources

## 2.8.1 Introduction

The purpose of this analysis is to consider significant historic properties within the Pueblo Ridge Restoration Project area and potential effects to those resources from proposed project activities. While historic properties are not directly related to the purpose and need of the Pueblo Ridge Restoration Project, the identification, protection, integrity and preservation of significant historic properties is of utmost importance to the Carson National Forest staff, as well as a legal requirement for any Federal undertaking. In addition, Carson personnel, as well as the greater community, recognize the unmatched cultural and historical significance of the Taos Pueblo, which borders the project area. Currently, there are 9 known historic properties located within the Pueblo Ridge Restoration project area that could be potentially affected by project activities.

Design features and protective measures have been developed for these nine sites, as well as any new sites that may be identified prior to, during, or after project activities. Thepotential direct, indirect, and cumulative effects to these sites are expected to be minimal provided the design features and protective measures are adhered to for all project related activites..

The section 106 process must be complete prior to the implementation of any undertaking or activity associated with this project..

## 2.8.2 Topics and Issues Addressed in This Analysis

The only indicator of cultural resources is physical material evidence on the physical landscape. Sites are typically identified by physical survey and evaluation, or oral tradition. The majority of the area of potential effect has been physically surveyed and consulted upon, per the requirements of 36 CFR 800 and the forest plan (USDA Forest Service 1986), amendment 7. Nine sites located in the area of potential effect are considered eligible or potentially eligible  and may require protective measures. These measures include the flagging and protective avoidance of the site during all project activities. Sites that are not fire sensitive can be treated with low-intensity, prescribed fire.

## 2.8.3 Affected Environment

### 2.8.3.1 Existing Condition

Site AR-03-02-04-379 (hereafter referred to as the rock shelter) is a rock shelter that may yield information on prehistoric cultural activity. The shelter is approximately 0.026 acres in size and requires further investigation to determine if subsurface deposits exist. The site is recommended as eligible to the National Register of Historic Places (36 CFR 60.4). The physically durable rock shelter is protected from project activities and weather elements given its natural orientation and elevated situation on the landscape. This historical property is not fire sensitive and can be exposed to a low-intensity, prescribed burn. Since the site is eligible to the National Register of Historic Places, it does require protection from thinning activities.

Site AR-03-02-05-115 (hereafter referred to as the site) is a prehistoric habitation site with a possible historic component. The site was excavated for eligibility purposes and yields information about prehistoric cultural activity, including three projectile points. These diagnostic artifacts suggest the site may have been occupied between 500-700 AD. A possible historic component consisting of ceramics suggests the site may have also been occupied between 1550-1850 AD. The site is approximately 1.64 acres. This site is eligible for listing to the National Register of Historic Places. The New Mexico State Historic Preservation Officer has concurred with the eligibility status. This site is fire sensitive and as a result requires protection from project activities.

Site AR-03-02-05-116 (hereafter referred to as the site) is a prehistoric lithic scatter including three diagnostic projectile points. These artifacts suggest the site was created between 1,000 BC and 1,450 AD. The site occupies and area of .88 acres and demonstrates potential for subsurface deposits. The eligibility status of the site is unevaluated for listing on the National Register of Historic Places. Since the site is unevaluated, it should be treated as eligible for listing until a formal determination has been completed (36 CFR 60.4). This site is not fire sensitive and can be exposed to a low-intensity, prescribed burn. This site does require protection from thinning activities.

Site AR-03-02-05-151 (hereafter referred to as the site) is a historic midden, approximately 0.013 ares in size. The site consists of historic trash, including ceramics, glass, and metal. Further site investigation could determine a general time the site was deposited, the presence or absence for additional deposits, and to evaluate its eligibility status for the National Register of Historic Places. Since the site is unevaluated, it should be treated as eligible for listing until a formal determination has been completed (36 CFR 60.4). This site is fire sensitive and requires protection from project activities.

Site AR-03-02-05-261 (hereafter referred to as the site) is a prehistoric lithic scatter including more than 20 cobbles, partial bifaces and projectile point, and several flakes. This site measures approximately 0.58 acres and suggests the possibility for intact subsurface deposits. The eligibility status of the site is unevaluated for listing on the National Register of Historic Places. Since the site is unevaluated, it should be treated as eligible for listing until a formal determination has been completed (36 CFR 60.4). The site is not fire sensitive and can be exposed to a low-intensity, prescribed burn. This site requires protection from thinning activities.

Site AR-03-02-04-182 (hereafter referred to as the site) is a historic spring, measuring approximately 0.21 acres in size. Glass, metal, and wooden artifacts suggest the site (still in use today) may have been in use as early as 1912. Additional testing would determine if intact, subsurface deposits represent prehistoric use of the site. The eligibility status of the site is unevaluated for listing on the National Register of Historic Places. Since the site is unevaluated, it should be treated as eligible for listing until a formal determination has been completed (36 CFR 60.4). This site is fire sensitive and requires protection from projet activities.

Site AR-03-02-04-183 (hereafter referred to as the site) is an unknown dual component historic site, represented by two features of three cobble mounds and cobble alignment. Two cobble mounds lack obvious cultural and temporal affiliations. Another cobble alignment may represent the initials of someone and suggest an Anglo/Hispanic affiiation dating from 1930-1960. The site occupies an area of approximately 0.096 acres. The presence of subsurface deposits is unknown. The eligibility status of the site is unevaluated for listing on the National Register of Historic Places. Since the site is unevaluated, it should be treated as eligible for listing until a formal determination has been completed (36 CFR 60.4). This site is fire sensitive and requires protection from project activities.

Site AR-03-02-04-184 (hereafter referred to as the site) is a historic water system and midden, occupying an area of 0.70 acres. The site consists of a cement and stone masonry spring box and cistern; a cast cement wall cistern, and a historc can dump. A cultural affiliation of Anglo/Hispanic has been assigned to the site, with a modern temporal affiliation of 1945 to 2002. The site is no longer in use. The eligibility status of the site is unevaluated for listing on the National Register of Historic Places. Since the site is unevaluated, it should be treated as eligible for listing until a formal determination has been completed (36 CFR 60.4). This site is fire sensitive and requires protection from project activities.

Site AR-03-02-04-298 (hereafter referred to as the site) is a prehistoric resource and processing site, measuring .094 acres in size. The site lacks diagnostic artifacts and consists of a single, slab lined pit feature and one basalt, secondary flake. There may be intact buried cultural deposits that could provide diagnostic and temporal information. Because the site may yield important information about the area, AR-03-02-04-298 is recommended eligible for listing in the National Register of Historic Places. This site is not fire sensitive and can be exposed to a low-intensity, prescribed burn. This site requires protection from thinning activities.

Sites that may be located during or after project activities would follow the analysis process outlined by Carson National Forest personnel and per 36 CFR 800 regulations. This process includes the halting of project activities, field inspection of the site by a Carson National Forest archaeologist, and an assessment of effects and future steps and mitigation measures.

## 2.8.4 Environmental Consequences

### 2.8.4.1 Alternatives 1 and 2

#### *Project Design Features and Mitigation Measures*

The potential direct and indirect effects to the sites are expected to be minimal regardless of alternative. The rock shelter, prehistoric lithic scatters, prehistoric areas of occupation or processing, historic midden, historic rock features, and historic springs or historic well features are located in areas proposed for treatment is located in an area proposed for timber thinning.

Design features and protective measures for timber harvest activities and prescribed burns have been developed to minimize effects to this sites. The lack of vegetation around any sitethe site implies a minimal risk for both types of project activities. Regardless, the mandatory mitigation measure of 50-foot avoidance around the sitese site would ensure protection from effects. Furthermore, sites deemed as fire sensitive (AR-03-02-04-184, AR-03-02-04-183, AR-03-02-04-182, AR-03-02-05-151, and AR-03-02-05-115), will be excluded from prescribed burning activities with a blackline around them to prevent any potential effects from burning. These sites contain artifacts or features that may be altered by high tempreatures or low burning. These mitigation measures are standard across the Carson and have been demonstrated to be effective in past Carson National Forest undertakings. These mitigation measures reduce any reasonably foreseeable potential effects to the site.

*Cumulative Effects – Alternatives 1 and 2.*

Since there are minimal direct or indirect effects of either alternative, there are no cumulative effects.

### 2.8.5 Other Relevant Mandatory Disclosures

As noted above, additional survey and consultation is required to complete the Section 106 compliance for this entire project area. Carson National Forest personnel will complete those obligations prior to implementation following procedures outlined in the "First Amended Programmatic Agreement Regarding Historic Property Protection And Responsibilities Among New Mexico Historic Preservation Officer And Arizona State Historic Preservation Officer And Texas State Historic Preservation Officer And Oklahoma State Historic Preservation Officer And The Advisory Council On Historic Preservation And United States Department Of Agriculture Forest Service Region 3". To date, the New Mexico State Historic Preservation Office has concurred with a determination of "no adverse effect" for the undertakings disclosed. A copy of this letter is available in the project record.

## 2.9 Range

### 2.9.1 Introduction

This section focuses on the effects of restoration treatments on rangeland resources on the Capulin and Fernandez grazing allotments, which are found partially within the project area.

### 2.9.2 Affected Environment

#### 2.9.2.1 Existing Condition

Part of the Capulin grazing allotment is located within the Pueblo Ridge Restoration project area and consists of 13,744 acres (figure 18). While there are many traditional uses of the area such as fuelwood gathering, piñon-nut gathering, hunting, and recreation, the area remains important for livestock grazing as well. The western part of the allotment is within the project boundary, some of the two eastern pastures are outside of the project boundary.

There is one permit issued to the Capulin Grazing Association, which includes three members. The management system on the allotment is a four-pasture, deferred-rotation system. The amount of cattle authorized annually is determined by the resource condition at the time of entry, rotation schedule, and the capacity of the pastures to be used during the season of use. The season of use is from June 1st or June 15th to September 30th, and permitted numbers are 59 head (55 cow/calf pairs and 4 bulls). The season of use would be June 1st when entering the Capulin pasture and June 15th in years entering the Ok pasture which is outside the project area.

Fair to good conditions occur across the allotment, with approximately 400 pounds per acre of grass produced in the key areas, which are locations in the allotment where monitoring occurs. Grasses include some blue grama, smooth brome, June grass, and blue grass. Utilization standards do not exceed 40 percent by weight of annual available forage in key forage areas, and 4-inch stubble height is maintained in riparian zones with grasses and forbs.

Within the Capulin allotment, the elevation extends from 7,200 to 10,470 feet. In general, elevations on the allotment increase from west to east and from south to north. Corresponding vegetation types from west to east are piñon/juniper, ponderosa pine-oak, and mixed conifer with aspen. Mountain grasslands are interspersed within these vegetation types. The 1996 analysis of the Capulin allotment, along with annual range inspection reports, demonstrated range, soil, and watershed conditions have improved. Areas west of the Capulin Canyon are less likely to be grazed due to encroachment of trees and shrubs, while some past timber harvest areas from the late 1970s now provide good foraging opportunities.

There is a small section of the Fernandez grazing allotment in the project area that is south of Highway 64. This area is primarily used for recreation with the La Sombra and Capulin Campgrounds located in this area. The Fernandez grazing allotment is currently vacant and not planned to be grazed during the life of this project. This analysis will not include further information on the Fernandez allotment.

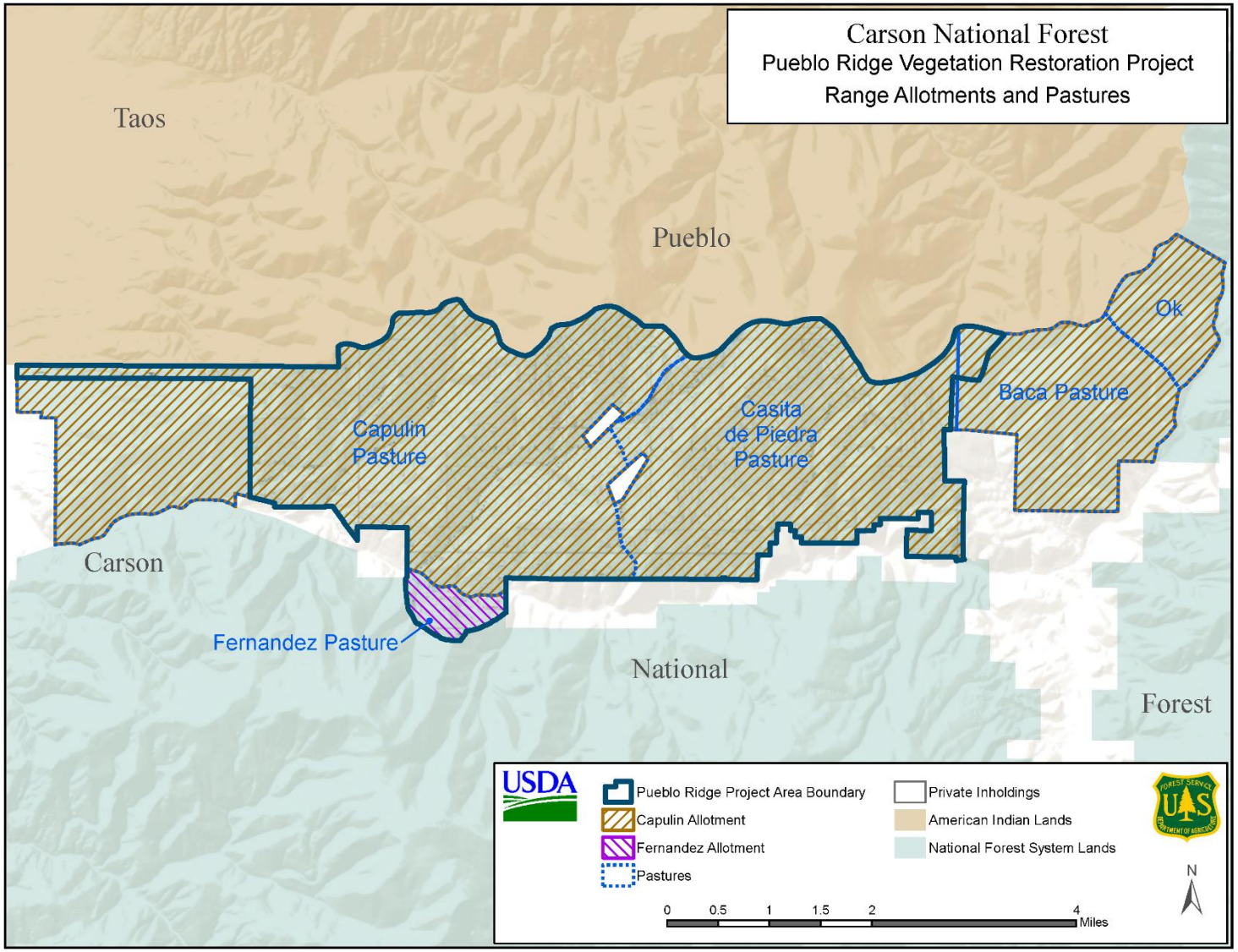


**Figure 18. Pueblo Ridge Restoration project area and the Capulin allotment**

## 2.9.3 Environmental Consequences

### 2.9.3.1 Direct and Indirect Effects for Vegetation and Fuels Treatments for Alternatives 1 and 2

The dense timbered stands within the project area do not provide even livestock distribution. Thinning of forested areas under both alternatives would improve distribution and provide increased levels of herbaceous forage. Higher-elevation sites and those in the ponderosa pine and piñon/juniper cover type would show the greatest improvements following treatment. Forage production would increase within one to five years following project implementation due to an increase in sunlight reaching the forest floor. These effects would last approximately 10 to 20 years until canopies begin to close and competition for sunlight, moisture, and nutrients increases with stand density.

The use of prescribed fire within treatment units would reduce conifer encroachment in meadows and aspen stands, increasing available forage for livestock and wildlife over the long term. Prescribed burning would have an effect on livestock grazing in the short term by removing available forage and decreasing range readiness in some areas. This effect would be offset by the long-term increase in forage as a result of regrowth and nutrient cycling provided by low-severity fire. With maintenance treatments over the long term, a natural fire regime would be reestablished that would maintain forage production at a higher level than current production. The use of prescribed fire within revegetation areas would help to inhibit sagebrush encroachment and maintain the areas as grasslands, thereby increasing available forage over the long term for livestock and wildlife.

There would be minimal and managed direct and indirect effects to livestock management from the proposed activities in both alternatives. These effects would be minimal considering that treatments would be located in more heavily timbered stands which, given their current condition, are not favored grazing areas for cattle. Short-term impacts to grazing could include alterations in pasture use during harvest activities and temporary reductions in available forage.Project design features would ensure coordination between range, timber, and fire staff during project implementation. Adaptive management techniques, such as flexible grazing schedules, pasture rotations, period of use, and entry and exit dates, would continue to be utilized to adjust livestock numbers to meet annual forage production requirements. Any modifications to allotment management as a result of project activities would be made in coordination, cooperation, and consultation with permittees to minimize potential effects to grazing operations. Additionally, prescribed burning activities would be conducted under weather conditions that would minimize the potential for adverse effects to range improvements and other infrastructure.

If a burned area does not recover within a year, this could reduce the amount of rotational grazing available on the allotment and could lead to a temporary reduction in livestock numbers or a reduction in the length of the grazing season in order to maintain the health of the burned pasture until the treatment area can recover and rotational grazing can be restored.

Both alternatives would improve livestock distribution across the project area, the Capulin allotment, and within treatment units where an increase in openings and a decrease of woody species cover would produce desirable grass and forb growth in various strategic locations throughout pastures. Thinning of densely forested areas would improve distribution by moving cattle away from the openings where they currently concentrate.

The alternatives could result in additional short-term direct effects to grazing management as a result of road maintenance, increased traffic within the project area, cross-country travel within cutting units, other ground-disturbing activities, and thinning operations in general. Similar activities have been conducted throughout the project area in the past with few long-term effects to livestock grazing operations.

Project design features would also mitigate any potentially adverse effects to range infrastructure and grazing operations. If range infrastructure were to be impacted by project activities, Carson staff would work with permittees to replace damaged infrastructure.

In summary, although the alternatives could result in short-term effects to forage availability and allotment management, project implementation would benefit rangeland condition over the long term for livestock and wildlife. Short-term effects as a result of project activities would not be significant with implementation of best management practices and project design features that would minimize potentially adverse effects.

#### 2.9.3.2 Direct and Indirect Effects for Roads and Improvements (Spring Developments, Guzzlers, and Corral) for Alternatives 1 and 2

The pasture rotations on the allotment start on the east side of the allotment and go west one year and then the next year start east and go west. Sometimes these pastures have limited water, and the additional guzzlers and springs would increase the ability to enter the pastures when the forage has reached range readiness. Distribution, as well as improve overall utilization and flexibility for this rotation, would be increased.

A corral in the Capulin pasture would also enable permittees to more fully utilize the pasture. The corral would ensure cattle could easily be gathered from a pasture and reduce the potential for stray cattle to remain on the pasture after their scheduled removal date.

The proposed guzzlers are the umbrella type with a 3,500-gallon capacity. They are designed to catch rain and snow storing the water in a large tank. A pipe would carry the water to a nearby drinker. The guzzlers would be useful in wetter years but do not provide a permanent water source due to their dependence on precipitation to catch water. The guzzlers would provide water to both livestock and wildlife.

Proposed road management activities would not affect livestock management of the Capulin Allotment. Coordination during project implementation would occur to ensure livestock management continues to run smoothly during the project. Roads proposed for decommissioning do not include roads needed for permit administration.

##### *Direct and Indirect Effects for Roads and Improvements (Spring Developments, Guzzlers, and Corral) specific to Alternative 1*

The Capulin allotment has developed waters within the project area. Alternative 1 includes two guzzlers and up to nine spring developments in the Capulin and Casita de Piedra pastures. On the west side of the allotment, the 7,044-acre Capulin pasture is the largest and driest, with livestock use mostly in the northeast.

Improving up to nine springs would increase cattle distribution when forest thinning is implemented, increasing forage in these pastures. These springs would provide water that is critically needed for livestock and wildlife, especially in drought years, across the allotment. A more even distribution of livestock within the pastures and effective utilization of both pastures would contribute to general forest health by avoiding a concentration of effects that can lead to head cuts, soil compaction, and soil erosion at the limited number of existing water sources and range infrastructure within the project area.

#### *Direct and Indirect Effects for Roads and Improvements (Spring Developments, Guzzlers, and Corral) specific to Alternative 2*

Alternative two includes two guzzlers and up to four spring developments in the Capulin and Casita de Piedra pastures. On the west side of the allotment, the 7,044-acre Capulin pasture is the largest and driest with livestock use mostly in the northeast.

Improving up to four springs would slightly increase cattle distribution when forest thinning is implemented, slightly increasing forage in these pastures. These springs would provide water in some areas of the allotment that is critically needed for livestock and wildlife, especially in drought years. A slightly more even distribution of livestock within the pastures and effective utilization of both pastures would contribute to general forest health by avoiding a concentration of effects that can lead to head cuts, soil compaction, and soil erosion at the limited number of existing water sources and range infrastructure within the project area.

### 2.9.3.3 Cumulative Effects

#### *Past, Present, and Reasonably Foreseeable Future Activities*

Appendix B lists the activities considered as past, present, and reasonably foreseeable future activities that overlap in time and geographic space with the alternatives presented in the range analysis. The area of cumulative effects for the purposes of this project is defined as the grazing allotments in which this project occurs though cumulative impacts analysis may include differing spatial or temporal bounds, depending on the resource under consideration.

Past, present, and reasonably foreseeable activities considered are timber management, utility line, fuelwood, and prescribed fire projects. While there may be short-term impacts to grazing management due to reduced vegetation growth and forage in treated areas, this impact would likely be less than one year in duration. Levels of available forage are expected to increase in the years following treatment as heavily timbered stands are opened up.

Grazing inherently alters the herbaceous layer and can exacerbate effects of fire suppression through retardation of fire spread by removing those fuels that carry fire. The reintroduction of fire into the project area would maintain openings, keep natural regeneration at manageable levels, and recycle nutrients. Though these effects overlap in time and space within the Pueblo Ridge Restoration Project, in most cases, they are not the same types of effects anticipated with implementation of the proposed project.

Project activities would have the combined beneficial effect of distributing the effects of livestock grazing across the landscape, which contributes to general forest health by avoiding a concentration of effects that can lead to head cuts, soil compaction, and soil erosion at the limited number of existing water sources and range infrastructure within the project area.

Grazing by both wild and domestic animals, as well as drought, could limit the full recovery of understory species within the project area. Prescribed fire and other project activities have the potential to cause short-term, localized soil erosion and loss of ground cover, but these effects would be mitigated through best management practices and project design features and would be further offset in the long term by regrowth of understory species and ground cover, the production of desirable grasses and forbs, and improved livestock distribution. Ultimately the cumulative effects from vegetation and fuels treatments would be a long-term benefit to rangeland resources; therefore, the proposed action would not result in any significant cumulative adverse effects.

Improving springs under both alternatives would increase cattle distribution when the thinning is done and increased forage in these pastures. A more even distribution of livestock within the pastures and effective utilization of both pastures would occur in combination with increased forage production from the vegetation and fuels treatments and would cumulatively contribute to general forest health by increasing the existing water sources and range infrastructure within the project area.

Because the effects to understory species and range resources from both alternatives are positive, the alternatives are expected to positively add to the understory species and range resources incrementally. The alternatives are expected to improve livestock management so they would positively add incrementally to the effects to the understory species from the vegetation and fuels treatments.

#### 2.9.3.4 Summary of Environmental Effects

In summary, although the proposed action could result in short term impacts to forage availability and allotment management, project implementation would benefit rangeland condition over the long term. Short-term impacts as a result of project activities would not be significant with implementation of best management practices and project design features that would minimize potentially adverse effects.

# 3. Agencies and Persons Consulted

Forest Service personnel consulted the following Federal, State, and Tribal agencies during the development of this environmental assessment:

## 3.1 Federal, State, and Local Agencies and Tribes

- U.S. Fish and Wildlife Service
- New Mexico Department of Game and Fish
- New Mexico State Historic Preservation Office
- Comanche Tribe of Oklahoma
- Hopi Tribe
- Jicarilla Apache Nation
- Navajo Nation
- Ohkay Owingeh
- Pueblo of Jemez
- Pueblo of Nambe
- Pueblo of Picuris
- Pueblo of Pojoaque
- Pueblo of San Ildefonso
- Pueblo of Santa Clara
- Pueblo of Taos
- Pueblo of Tesuque
- Pueblo of Zuni
- Southern Ute Indian Tribe
- Ute Mountain Ute Tribe

# 4. Finding of No Significant Impact

The following is a summary of the project analysis to determine significance, as defined by 40 CFR 1508.27 and by Forest Service Handbook 1909.15_05. “Significant” as used in the National Environmental Policy Act process requires consideration of both context and intensity of the anticipated effects of a project.

## 4.1 Context

**Context** means that the significance of an action must be analyzed in several contexts (local, regional, worldwide), and over short and long time frames. Significance varies with the setting of a proposed action. For site-specific actions, significance usually depends upon the effects in the locale rather than in the world as a whole.

The Camino Real Ranger District encompasses approximately 319,109 acres located in northcentral New Mexico. The Pueblo Ridge Restoration Project encompasses 9,724 acres (including 15 acres of private inholdings) and is located on the Camino Real Ranger District.

This project is a site-specific activity which does not have statewide, regional, national, or international implications. Proposed treatments would improve the health and sustainability of forested conditions in, and surrounding, the project area by reducing hazardous fuels and moving vegetative conditions in the project area toward the desired conditions. Potential adverse effects of the approved treatments would be minimized through implementation of project design features and monitoring guidelines outlined on pages 23 through 39 of this document. The scope of this project is limited to the project area. Thus, the context of this project indicates effects of implementing alternative 1 are localized and not significant.

## 4.2 Intensity

**Intensity** refers to the severity of the anticipated project effects and is defined by the ten factors identified in 40 CFR 1508.27(b) and listed below. The evaluation of intensity is based on information from the effects analysis in the environmental assessment and specialist reports for this project.

1) **Impacts may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial.**

   Both beneficial and adverse effects have been considered for alternative 1 and are disclosed in section 2 of the environmental assessment. While the project may result in adverse effects to certain resources, these effects have been determined to be localized and largely short term in duration. Beneficial effects were not used to minimize the severity of adverse effects in consideration of this project. This project would not result in significant irretrievable or irreversible commitments or losses of resources.

2) **The degree to which the proposed action affects public health or safety.**

   Alternative 1 would not have a significant adverse effect on public health or safety. Treatments would be implemented in accordance with standard safety measures and procedures.

**3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.**

Alternative 1 would not adversely affect unique characteristics of the geographical area. Project design features would be incorporated to avoid adverse effects to historic or cultural resources, and to avoid or minimize impacts to wetlands. There are no designated wild and scenic rivers in the project area, and there are no other ecologically critical areas, such as wilderness areas, wilderness study areas, inventoried roadless areas, or research natural areas, present within the project boundary. The Taos Pueblo Blue Lake Wilderness area borders the project area to the north but would not be affected by any of the proposed actions.

**4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.**

This factor pertains to disagreement between experts in a given field over the potential effects of a project. Public concerns and input have been considered throughout the analysis process. Comments received for the project did not provide evidence that effects of alternative 1 have been wrongly predicted, though comments did elicit clarifications and modifications in the environmental assessment. While there may be disagreement regarding certain components of the project, there is no unusual or high degree of controversy related to the anticipated effects of the project.

**5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.**

Alternative 1 does not include activities which pose potential effects that are highly uncertain or involve unique or unknown risks. The Carson National Forest has considerable experience implementing the types of activities in alternative 1. Potential effects of proposed actions in alternative 1 have been analyzed and disclosed in section 2 of the environmental assessment.

**6) The degree to which the action may establish precedent for future actions with significant effects or represents a decision in principle about a future consideration.**

Alternative 1 is not likely to establish a precedent for future actions with significant effects nor does it represent a decision in principle about a future consideration. This project is site specific, and alternative 1 is compliant with the Carson forest plan and other laws and regulations. Future actions not authorized under this decision would be evaluated through the environmental analysis process and would be assessed based on their own environmental effects and project feasibility.

**7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.**

The project was evaluated and analyzed with consideration for cumulative effects of past, present, and reasonably foreseeable future activities, as listed in section 2 of the environmental assessment. Alternative 1 would not result in significant cumulative effects, as disclosed under each resource heading in section 2 of the environmental assessment

**8) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.**

With incorporation of project design features, this project would not result in significant adverse effects to scientific, cultural, or historical resources. Multiple cultural resource surveys have been conducted within the project area. Where cultural or historical sites that are eligible (or undetermined) for listing in the National Register of Historic Places have been located and identified, project design features would be implemented to avoid potentially adverse effects.

**9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.**

This project is not anticipated to result in significant adverse effects to federally listed species or their designated critical habitats. The potential effects of the project on federally listed species is analyzed and disclosed in the "Wildlife" section of the environmental assessment (page **Error! Bookmark not defined.**).

A determination of "may affect, not likely to adversely affect" was made for the Mexican spotted owl for alternative 1. Due to the limited temporary negative effects on habitat or individuals and the likelihood, reduction in risk of habitat loss to stand replacement fire, and consistency with management recommendations contained in the 2012 recovery plan for improved habitat quality after implementation activities, alternative 1 may affect but is not likely to adversely affect the Mexican spotted owl.

A determination of may "may affect, not likely to adversely affect" was made for the Canada lynx for alternative 1. Alternative 1 may reduce habitat suitability on 51 acres and temporarily alter the behavior of individual lynx temporarily dispersing from Colorado to New Mexico. However, there is no evidence of lynx occurrence or potential for home range persistence in the project area. In addition, treatments on 51 acres would not affect lynx movements at the landscape level. Therefore, the effects of the proposed action are likely insignificant or discountable for the Canada lynx; thus the proposed actions in alternative 1 may affect but are not likely to adversely affect the Canada lynx.

There is no designated critical habitat for any federally listed species located within the project area

**10) Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.**

The project would not violate applicable Federal, State, or local laws or requirements for protection of the environment. Applicable laws, regulations, and policy were considered in the planning for this project, and are listed in appendix D of the environmental assessment.

# 5. References

## 5.1 Silviculture and Forestry

Curtis, R.O. 1970. Stand density measures: an interpretation: Forest Science 16(4): 403−414.

Ernst, R.L. and W.H. Knapp, 1985. Forest stand density and stocking: concepts, terms, and the use of stocking guides. Washington, DC: U.S. Dept. of Agriculture, Forest Service. Gen. Tech. Rep WO-44. 8 p.

Goforth, B.R., and R.A. Minnich. 2008. Densification, stand-replacement wildfire, and extirpation of mixed-conifer forest in Cuyamaca Rancho State Park, southern California. Forest Ecology and Management 256 (2008)

Helms, J.A. 1998. The dictionary of forestry. Society of American Foresters. Bethesda, MD. 210 p.

Keyser, C. 2009. Personal conversation on the how the inland California Southern Cascades variant of FVS calculates a weighted average for the relative density of stands.

Oliver, W.W. and F.C.C. Uzoh. 1997. Maximum stand densities for ponderosa pine and red and white fir in northern California. Proceedings of the 18th Annual Forest Vegetation Management Conference Sacramento, CA, January 14–16, 1997. p. 57–65.

Reineke, H.L. 1933. Perfecting a stand-density for even-aged forests. Journal of Agricultural Research 46**:** 627–638.

Smith, D.M., B.C. Larson, M.J. Kelty, and P.M.S. Ashton. 1997. The practice of silviculture: applied forest ecology. John Wiley, New York, New York, USA.

Smith, F. W. and A. Smith. E.2005. Twenty-year change in aspen dominance in pure aspen and mixed aspen/conifer stands on the Uncompahgre Plateau, Colorado, USA:

Taylor, A.H. 2006. Forest changes since Euro-American settlement and ecosystem restoration in the Lake Tahoe Basin, USA. USDA Forest Service Gen. Tech. Rep. PSW-GTR-203.

Worrall L.E., T. Eager, R. Mask, E. Johnson, P. Kemp, and W. Shepperd. 2007. Sudden aspen decline in southwest Colorado: site and stand factors and a hypothesis on etiology. In The 55th Western International Forest Disease Work Conference, Sedona, AZ, pp. 63–66.

## 5.2 Fire and Fuels

Agee J.K. 1993. Fire ecology of Pacific Northwest forests. Washington (DC): Island Press. 493 p

Agee, J.K. 1996. The influence of forest structure on fire behavior. In: Proceedings of the 17th Annual Forest Vegetation Management Conference, January 16–18, 1996. Redding, CA. pp. 52–68.

Agee, J.K., B. Bahro, M.A. Finney, P.N. Omi, D.B. Sapsis, J.W. Van Wagtendonk, C.N. Skinner, and C.P. Weatherspoon. 2000. The use of shaded fuel breaks in landscape fire management. Forest Ecol. Manage. 127: 55–66.

Anderson, H.E. 1982. Aid to determining fuel models for estimating fire behavior. USDA Forest Service Intermountain Forest and Range Experiment Station. GTR INT-122.

Andrews, P.L. and R.C. Rothermel. 1982. Charts for interpreting wildland fire behavior characteristics. General Technical Report INT-131, 21 p. Ogden, UT: USDA Forest Service, Intermountain Forest and Range Experiment Station.

Andrews, P.L. 2013. Current status and future needs of the BehavePlus Fire Modeling System. International Journal of Wildland Fire 23(1):21-33

Barrett, S., D Havlina, J. Jones, W. Hann, C. Frame, D. Hamilton, K. Schon, T. Demeo, L. Hutter, and J. Menakis. 2010. Interagency fire regime condition class guidebook. Version 3.0 [Homepage of the Interagency Fire Regime Condition Class website, USDA Forest Service, US Department of the Interior, and The Nature Conservancy]. [Online], Available: https://www.landfire.gov/frcc/frcc_guidebooks.php.

Byram, G. 1959. Chapter 3: Combustion of forest fuels. In K.P. Davis. Forest fire control and use. McGraw Hill Book Company: New York, Toronto, London. Pp. 61 – 89.

Cohen, J. 2008. The wildland-urban interface fire problem: A consequence of the fire exclusion paradigm. Forest History Today. Fall: 20-26.

Cohen, J.D. and B.W. Butler. 1998. Modeling potential ignitions from flame radiation exposure with implications for wildland/urban interface fire management. In: proceedings of the 13th conference on fire and forest meteorology, vol. 1; 1996 October 27–31; Lorne, Victoria, Australia. Fairfield, WA: International Association of Wildland Fire: 81-86.

Debano, L.F., D.G. Neary, and P. F. Ffolliott. 1998. Fire's effects on ecosystems. John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012. p 331 https://www.frames.gov/catalog/1331

Fitzgerald, S.A., 2005. Fire ecology of ponderosa pine and the rebuilding of fire resilient ponderosa pine ecosystems. In: M.W. Ritchie, D.A. Maguire, and A. Youngblood, technical coordinators. Proceedings of the symposium on ponderosa pine: issues, trends and management, Klamath Falls, Oregon. USDA Forest Service, General Technical Report PSW-GTR-198. Pacific Southwest Research Station, Albany, CA, pp. 197–226.

Gardiner, R. 2016. Taos County community wildfire protection plan update- connecting communities and watersheds.

Graham, R.T., A.E. Harvey, T.B. Jain, and J.R. Tonn. 1999. The effects of thinning and similar stand treatments on fire behavior in western forests. Gen. Tech. Rep. PNW-GTR-463. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 27 p.

Graham, R.T., S. McCaffrey, and T.B. Jain, technical editors. 2004. Science basis for changing forest structure to modify wildfire behavior and severity. Gen. Tech. Rep. RMRS-GTR-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 43 p.

Hann, W.J. and D.L. Bunnell. 2001 Fire and land management planning and implementation across multiple scales. Int. J. Wildland Fire. 10: 389-403.

Hardy, C.C., K.M. Schmidt, J.M. Menakis, N.R. Samson. 2001. Spatial data for national fire planning and fuel management. International Journal of Wildland Fire 10: 353-372

Hardy, C.C. 2005. Wildland fire hazard and risk: Problems, definitions, and context. Forest Ecology and Management 211: 73-82.

Headwaters Economics. 2016. Assessing wildfire risk in Taos County, New Mexico. A reference document. Bozeman, MT

Hessburg, P.F., J.K. Agee, and J.F. Franklin. 2005. Dry mixed-conifer forests and wildland fires of the Inland Northwest: contrasting the landscape ecology of the pre-settlement and modern eras. Forest Ecology and Management. 211: 117–139.

Johnson, L. and E. Margolis. 2017. Final progress report. Tree-ring fire history of the Taos Valley watersheds, Sangre de Cristo Mountains, New Mexico. Prepared by New Mexico Landscapes Field Station USGS/NPS for the Nature Conservancy.

Keely, J.E. 2009. Fire intensity, fire severity, and burn severity: A brief review and suggested usage. International Journal of Wildland Fire 18(1): 116-126.

Laughlin, D.C., R.T. Strahan, D.W. Huffman, and A.J. Sánchez Meador. 2016. Using trait-based ecology to restore resilient ecosystems: historical conditions and the future of montane forests in western North America. Restoration Ecology 0. (Unpublished).

Lotan, J.E., B.M. Kilgore, W.C. Fischer, and R.W. Mutch. 1985. Proceedings - Symposium and workshop on wilderness fire; November 15, 1983; Missoula, Montana. General Technical Report. INT-GTR-182. USDA Forest Service. 434 p.

National Park Service. 2018. Class I areas. Available at https://www.nps.gov/subjects/air/class1.htm

Neilsen, M. 2015. Aspen helped slow forest fire, anti-herbicide activist says. Document available at: https://www.princegeorgecitizen.com/news/local-news/aspen-helped-slow-forest-fire-anti-herbicide-activist-says-1.1952535

Omi, P.N. and E.J. Martinson. 2002. Effects of fuel treatment on wildfire severity, final Report. Joint Fire Science Program, Western Forest Fire Research Center. Colorado State University. Ft. Collins, CO.

Pyne S.J. 1982. Fire in America, a cultural history of wildland and rural fire. Seattle (WA): University of Washington Press. 654 p.

Reynolds, R.T., A.J. Sánchez Meador, J.A. Youtz, T. Nicolet, M. S. Matonis, P.L. Jackson, D.G. DeLorenzo, and A.D. Graves. 2013. Restoring composition and structure in southwestern frequent-fire forests: A science-based framework for improving ecosystem resiliency. USDA Rocky Mountain Research Station RMRS-GTR-310. Available at: http://www.fs.fed.us/rm/pubs/rmrs_gtr310.pdf

Reynolds, R.T.; R.T. Graham, M. Hildegard Reiser, R.L. Bassett, P.L. Kennedy, D.A. Boyce, Jr., G. Goodwin, R. Smith, and E.L. Fisher. 1992. Management recommendations for the northern goshawk in the southwestern United States. Gen. Tech. Rep. RM-217, Ft. Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 90 p.

Rodman, K.C., A.J. Sánchez Meador, D.W. Huffman, and K.M. Waring. 2016. Reference conditions and historical fine-scale spatial dynamics in a dry mixed-conifer forest, Arizona, USA. For. Sci. 62: (0, unreleased).

Rothermel, R.C. 1972. A mathematical model for predicting fire spread in wildland fuels. Research Paper INT-115. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 40 p.

Rothermel, R.C. 1983. How to predict the spread and intensity of forest and range fires. Gen. Tech. Rep. INT-143. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 161 p.

Ryan K.C. and N.V. Noste. 1985. Evaluating prescribed fires. In J.E. Lotan, B.M. Kilgore, W.C. Fischer, and R.W. Mutch, editors. Proceedings, symposium, and workshop on wilderness fire, 15–18 November 1983, Missoula, MT.

Ryan, K.C. 2002. Dynamic interactions between forest structure and fire behavior in boreal ecosystems. Silva Fennica 36: 13–39

Schmidt, K.M., J.P. Menakis, C.C. Hardy, W.J. Hann, and D.L. Bunnell. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 41 p.

Scott, J.H. and E.D. Reinhardt. 2001. Assessing crown fire potential by linking models of surface and crown fire behavior. Research Paper RMRS-RP-29. Fort Collins, CO: U.S.

Scott, J.H. and E.D. Reinhardt, compilers. 2007. FireWords: Fire science glossary. Version 1.0, [Online]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://firewords.net [2013, December 11].

Scott, J.H. 2003. Canopy fuel treatment standards for the wildland-urban interface. USDA Forest Service Proceedings, Rocky Mountain Research Station. Systems for Environmental Management, Missoula MT.

Shepperd, W.D. 2001. Manipulations to regenerate aspen ecosystems. Pages 355–365 in W. D. Shepperd, D. Binkley, D. L. Bartos, T. J. Thomas, and L. G. Eskew, compilers. Sustaining aspen in western landscapes: Symposium Proceedings. USDA Forest Service Rocky Mountain Research Station, RMRS-P-18, Grand Junction, Colorado

Skinner, C.N. and C.R. Chang. 1996. Fire regimes, past and present. In: Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, Assessment and scientific basis for management options. pp. 1041-1069. Davis: University of California, Centers for Water and Wildland Resources.

Sommers, W.T., S.G. Coloff, and S.G. Conard. 2011. Synthesis of knowledge: fire history and climate change. JFSP Project 09-02-1-09. Joint Fire Science Program. George Mason University. https://www.firescience.gov/JFSP_fire_history.cfm

Stratton, R.D. 2004. Assessing the effectiveness of landscape fuel treatments on fire growth and behavior. Journal of Forestry. October/November 2004

Stratton, R.D. 2006. Guidance on spatial wildland fire analysis: models, tools, and techniques. Gen. Tech. Rep. RMRS-GTR-183. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 15 p.

Turner M.G., W.W. Hargrove, R.H. Gardner, and W.H. Romme. 1994. Effects of fire on landscape heterogeneity in Yellowstone National Park, Wyoming. Journal of Vegetation Science 5, 731–742. doi:10.2307/3235886

USDA Forest Service. 1986. Carson National Forest land and resource management plan. USDA Forest Service. Southwestern Region. Carson National Forest.

USDA Forest Service. 2018. Aspen ecology. USDA Forest Service Rangeland Management and Vegetation Ecology-Botany Program. Accessed: March 2019 https://www.fs.fed.us/wildflowers/beauty/aspen/ecology.shtml

U.S. Department of the Interior, Geological Survey. LANDFIRE version 1.3.0. Spatial data layers for fuel models. Accessed 2018 at: http://landfire.cr.usgs.gov/

USDI and USDA. 2000. Managing the impacts of wildland fires on communities and the environment - a report to the President (aka National Fire Plan). Document available at: http://www.forestsandrangelands.gov/

USDI and USDA 2001. A collaborative approach for reducing wildland fire risk to communities and the environment 10 year comprehensive strategy. Implementation plan. Available at: http://www.forestsandrangelands.gov/

U.S. Environmental Protection Agency (EPA). 1998. Interim air quality policy on wildfire and prescribed fires. Final report. U.S. Environmental Policy Agency. Report available at: https://nepis.epa.gov/Exe/ZyNET.exe/9100JSKT.txt?ZyActionD=ZyDocument&Client=EPA&Index=1995%20Thru%201999&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5CZYFILES%5CINDEX%20DATA%5C95THRU99%5CTXT%5C00000027%5C9100JSKT.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=46&slide

U.S. Environmental Protection Agency. 1999. Regional haze regulations, final rule, 40 CFR Part 51. Document available at: https://www.govinfo.gov/content/pkg/FR-1999-07-01/pdf/99-13941.pdf

U.S. Fish and Wildlife Service. 2017. National Wildlife Refuge System website. Information accessed March 2019 at: https://www.fws.gov/invasives/staffTrainingModule/methods/burning/review.html

U.S. Fish and Wildlife Service. 2012. Final recovery plan for the Mexican spotted owl (*Strix occidentalis lucida*), First Revision. U.S. Fish and Wildlife Service. Albuquerque, New Mexico. 413 pp

Van Wagner, C.E. 1977. Conditions for the start and spread of crown fire. Canadian Journal of Forest Research 7: 23-34.

Wiedinmyer C. and M.D. Hurteau 2010. Prescribed fire as a means of reducing forest carbon emissions in the western United States. Environmental Science & Technology 44(6): 1926-1932

## 5.3 Terrestrial Wildlife

Altman, B. and R. Sallabanks. 2012. Olive-sided flycatcher (*Contopus cooperi*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/olsfly. Accessed 11 April 2017.

Angradi, T.R. and J.S. Griffith. 1990. Diet feeding chronology and diet selection of rainbow trout (*Oncorhynchus mykiss*) in the Henry's Fork of the Snake River, Idaho. Canadian Journal of Fisheries and Aquatic Science 47: 199-209.

Armstrong, D.M., B.H. Banta, and E.J. Pokropus. 1973. Altitudinal distribution of small mammals along a cross-sectional transect through the Arkansas River watershed, Colorado. The Southwestern Naturalist 17: 315-326.

Balda, R.P. 2002. Pinyon jay (*Gymnorhinus cyanocephalus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/pinjay. Accessed 11 April 2017.

Beatty, B., W. Jennings, and R. Rawlinson. 2004. *Delphinium robustum* Rydb. (Wahatoya Creek larkspur): A technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Retrieved from: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5206837.pdf. Accessed 3 April 2017.

Beier, P. and J.E. Drennan, 1997. Forest structure and prey abundance in foraging areas of northern goshawks. Ecological Applications 7: 564-571.

Bevier, L.R., A.F. Poole, and W. Moskoff. 2005. Veery (*Catharus fuscescens*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/veery. Accessed 11 April 2017.

[BISON-M] Biota Information System of New Mexico. 2017a. Canada lynx, updated 1/24/2017. Available at: http://www.bison-m.org/booklet.aspx?id=050325. Accessed 21 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017b. Meadow jumping mouse, updated 2/6/2017. Available at: http://www.bison-m.org/booklet.aspx?id=050410. Accessed 22 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017c. Bald eagle, updated 2/10/2017. Available at: http://www.bison-m.org/booklet.aspx?id=040370. Accessed 24 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017d. White-tailed ptarmigan, updated 2/6/2017. Available at: http://www.bison-m.org/booklet.aspx?id=041530. Accessed 24 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017e. Burrowing owl, updated 1/11/2017. Available at: http://www.bison-m.org/booklet.aspx?id=041320. Accessed 24 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017f. Boreal owl, updated 2/6/2017. Available at: http://www.bison-m.org/booklet.aspx?id=041315. Accessed 24 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017g. American pika, updated 1/5/2017. Available at: http://www.bison-m.org/booklet.aspx?id=050565. Accessed 24 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017h. Gunnison's prairie dog, updated 1/24/2017. Available at: http://www.bison-m.org/booklet.aspx?id=050206. Accessed 24 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017i. American marten, updated 2/6/2017. Available at: http://www.bison-m.org/booklet.aspx?id=050335. Accessed 24 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017j. Northern leopard frog, updated 1/11/2017. Available at: http://www.bison-m.org/booklet.aspx?id=020035. Accessed 27 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017k. Peregrine falcon, updated 2/13/2017. Available at: http://www.bison-m.org/booklet.aspx?id=040384. Accessed 24 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017l. Masked shrew, updated 1/26/2017. Available at: http://www.bison-m.org/booklet.aspx?id=050710. Accessed 29 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017m. Western water shrew, updated 12/21/2016. Available at: http://www.bison-m.org/booklet.aspx?id=050730. Accessed 29 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017n. Spotted bat, updated 2/6/2017. Available at: http://www.bison-m.org/booklet.aspx?id=050095. Accessed 29 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017o. Pale Townsend's big-eared bat, updated 1/24/2017. Available at: http://www.bison-m.org/booklet.aspx?id=050025. Accessed 30 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017p. Rio Grande sucker, updated 1/19/2017. Available at: http://www.bison-m.org/booklet.aspx?id=010515. Accessed 30 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017q. Rio Grande chub, updated 1/20/2017. Available at: http://www.bison-m.org/booklet.aspx?id=010140. Accessed 30 March 2017.

[BISON-M] Biota Information System of New Mexico. 2017r. Juniper titmouse, updated 2/10/2017. Available at: http://www.bison-m.org/booklet.aspx?id=042135. Accessed 4 April 2017.

[BISON-M] Biota Information System of New Mexico. 2017s. Hairy woodpecker, updated 2/8/2017. Available at: http://www.bison-m.org/booklet.aspx?id=042530. Accessed 5 April 2017.

[BISON-M] Biota Information System of New Mexico. 2017t. Wild turkey, updated 2/13/2017. Available at: http://www.bison-m.org/booklet.aspx?id=042170. Accessed 5 April 2017.

[BISON-M] Biota Information System of New Mexico. 2017u. Abert's squirrel, updated 4/8/2016. Available at: http://www.bison-m.org/booklet.aspx?id=050755. Accessed 6 April 2017.

[BISON-M] Biota Information System of New Mexico. 2017v. Red squirrel, updated 5/18/2016. Available at: http://www.bison-m.org/booklet.aspx?id=050810. Accessed 6 April 2017.

[BISON-M] Biota Information System of New Mexico. 2017w. Rainbow trout, updated 10/26/2015. Available at: http://www.bison-m.org/booklet.aspx?id=010615. Accessed 7 April 2017.

[BISON-M] Biota Information System of New Mexico. 2017x. Brown trout, updated 10/26/2015. Available at: http://www.bison-m.org/booklet.aspx?id=010575. Accessed 7 April 2017.

[BISON-M] Biota Information System of New Mexico. 2017y. Dusky grouse, updated 11/11/2016. Available at: http://www.bison-m.org/booklet.aspx?id=040700. Accessed 11 April 2017.

Boeker, E.L. and V.E. Scott. 1969. Roost tree characteristics for Merriam's turkey. Journal of Wildlife Management 33: 121-124.

Calamusso, B. and J.N. Rinne. 1996. Distribution of Rio Grande cutthroat trout and its co-occurrence with the Rio Grande sucker and Rio Grande chub on the Carson and Santa Fe National Forests. In D.W. Shaw, and D.M. Finch, technical coordinators. Desired future conditions for southwestern riparian ecosystems: bringing interests and concerns together. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-GTR-272. pp. 157-167.

Calamusso, B. and J.N. Rinne. 1999. Native montane fishes of the middle Rio Grande ecosystem: status, threats, and conservation. In: D.M. Finch, J.C. Whitney, J.F. Kelly, and S.R. Loftin, technical coordinators. Rio Grande ecosystems: linking land, water, and people. Toward a sustainable future for the Middle Rio Grande Basin. U.S.D.A. Forest Service, Rocky Mountain Research Station. Proc. RMRS-P-7, Ogden, Utah. pp 231-237.

Calamusso, B., J.N. Rinne, and P.R. Turner. 2002. Distribution and abundance of the Rio Grande sucker in the Carson and Santa Fe National Forests, New Mexico. The Southwestern Naturalist 47: 182-186.

Christman, B.J. 2001. Factors influencing pair territoriality in the juniper titmouse. The Condor 103: 361-369.

Cicero, C., P. Pyle, and M.A. Patten, 2017. Juniper titmouse (*Baeolophus ridgwai*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: https://birdsna.org/Species-Account/bna/species/juntit1. Accessed 4 April 2017.

Conway, C.H. 1952. Life history of the water shrew (*Sorex palustris navigator*).The American Midland Naturalist 48: 219-248.

Cook, J.G. 2002. Nutrition and food. In D.E. Toweill, and J.W. Thomas, editors. Elk of North America: ecology and management. Harrisburg, PA: Stackpole Books; pp 259-349.

Corn, P.S. and L.J. Livo. 1989. Leopard frog and wood frog reproduction in Colorado and Wyoming. Northwestern Naturalist 70:1-9.

Decker, K. 2006. *Salix arizonica* Dorn (Arizona willow): A technical conservation assessment. Rocky Mountain Region. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5206890.pdf. Accessed 3 April 2017.

Dodd, N.L., J.S. States, and S.S. Rosenstock. 2003. Tassel-eared squirrel population, habitat condition, and dietary relationships in north-central Arizona. Journal of Wildlife Management 67: 622-633.

Doumas, S.L, J.L. Koprowski, and W.O. Noble. 2015. Landscape-level assessment of Abert's squirrel; and red squirrel in mixed-conifer forest. The Southwestern Naturalist 60: 240-246.

Drennan, J.E. and P. Beier. 2003. Forest structure and prey abundance in winter habitat of northern goshawks. The Journal of Wildlife Management 67: 177-185.

Farentinos, R.C. 1972. Nests of the tassel-eared squirrel. Journal of Mammology 53: 900-903.

Ferner, J.W. 1974. Habitat relationships of *Tamiasciurus hudsonicus* and *Sciurus aberti* in the Rocky Mountains. The Southwestern Naturalist 18: 470-473.

Flyger, V. and J.E. Gates. 1982. Pine squirrels: *Tamiasciurus hudsonicus* and *T. douglassi*. In: J.A. Chapman and G.A. Feldhamer, editors. Wild mammals of North America: biology, management, and economics. Baltimore, MD: The John Hopkins University Press: 230-238.

Frey, J. 2004a. Abert's squirrel (*Sciurus aberti*) monitoring and habitat analysis on Carson National Forest, New Mexico, 2004. Final contract report 43-83A7-4-0038 completion report. Carson National Forest. December 9, 2004. 21 p.

Frey, J. 2004b. Red squirrel (*Tamiasciurus hudsonicus*) monitoring and habitat analysis on Carson National Forest, New Mexico, 2004. Final contract report 43-83A7-4-0038 completion report. Carson National Forest. December 9, 2004. 21 p.

Frey, J. 2006. Abert's squirrel (*Sciurus aberti*) monitoring and habitat analysis on Carson National Forest, New Mexico, 2006. Final contract report AG-83A7-P-06-0023 completion report. Carson National Forest. November 30, 2006. 41 p.

Frey, J. 2012. Survey for the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) on Carson National Forest, New Mexico. Final report submitted to Carson National Forest on 5 December 2012, 71 pp.

Frey, J. and T.L. Yates. 1996. Mammalian diversity in New Mexico. New Mexico Journal of Science 36: 4-37.

Ganey, J.L, W.M. Block, and S.H. Ackers. 2003. Structural characteristics of forest stands within home ranges of Mexican spotted owls in Arizona and New Mexico. Western Journal of Applied Forestry 18: 189-198.

Ganey, J.L., J.P. Ward Jr., and D.W. Willey. 2011. Status and ecology of Mexican spotted owls in the Upper Gila Mountains recovery unit, Arizona and New Mexico. Gen. Tech. Rep. RMRS-GTR-256WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 94 p.

Ganey, J.L., J.M. Iniguez, S. Hedwall, W.M. Block, J.P. Ward, Jr., R.S. Jonnes, T.A. Rawlinson, S.C. Kyle, and D.L. Apprill. 2016. Evaluating desired conditions for Mexican spotted owl nesting and roosting habitat. Forest Science 63: 1-6.

Greenwald, D.N., D.C. Crocker-Bedford, L. Broberg, K.F. Suckling, and T. Tibbitts. 2005. A review of northern goshawk habitat selection in the home range and implications for forest management in the western United States. Wildlife Society Bulletin 33: 120-128.

Gruver, J.C., and D.A. Keinath. 2006. Townsend's big-eared bat (*Corynorhinus townsendii*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Retrieved from: http://www.fs.usda.gov/detail/r2/landmanagement/?cid=stelprdb5177128.

Gurnell, J. 1984. Home range, territoriality, caching behavior, and food supply of the red squirrel (*Tamiasciurus hudsonicus fremonti*) in a subalpine lodgepole pine forest. Animal Behavior 32: 1119-1131.

Guzy, M.J. and P.E. Lowther. 2012. Black-throated gray warbler (*Setophaga nigrescens*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/btywar. Accessed 11 April 2017.

Gyug, L.W., R.C. Dobbs, T.E. Martin, and C.J. Conway. 2012. Williamson's sapsucker (*Sphyrapicus thyroideus*), In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/wilsap. Accessed 11 April 2017.

Hahn, T.P. 1996. Cassin's finch (*Haemorhous cassinii*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/casfin. Accessed 11 April 2017.

Haidekker, A. and D. Hering. 2008. Relationship between benthic insects (Ephemeroptera, Plecoptera, Coleoptera, Trichoptera) and temperature in small and medium-sized streams in Germany: a multivariate study. Aquatic Ecology 42: 463-481.

Haughland, D.L. and K.W. Larsen. 2004. Ecology of North American red squirrels across contrasting habitats: relating natal dispersal to habitat. Journal of Mammalogy 85: 225-236.

Hughes, J. 2015. Yellow-billed cuckoo (*Coccyzus americanus*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: https://birdsna.org/Species-Account/bna/species/yebcuc. Accessed 23 March 2016.

Interagency Lynx Biology Team. 2013. Canada lynx conservation assessment and strategy. 3rd edition. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication R1-13-19, Missoula, MT. 128 pp.

Irwin, L.L. 2002. Migration. In D.E. Toweill, and J.W. Thomas, editors. Elk of North America: ecology and management. Harrisburg, PA: Stackpole Books; pp 493-513.

Jackson, J.A., H.R. Ouellet, and B.J. Jackson. 2017. Hairy woodpecker (*Picoides villosus*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: https://birdsna.org/Species-Account/bna/species/haiwoo. Accessed 5 April 2017.

Jacobson, D.J., S. Rostgaard, and J.J. Vásconez. 2003. Are macroinvertebrates in high altitude streams affected by oxygen deficiency? Freshwater biology 48: 2025-2032.

Kaller, M.D. and K.J. Hartman. 2004. Evidence of a threshold level of fine sediments accumulation for altering benthic macroinvertebrate communities. Hydrobiologia 95-104.

Keith, J.O. 1965. The Abert's squirrel and its dependence on ponderosa pine. Ecology 46: 150-163.

Keith, J.O. 2003. Abert's squirrel (*Sciurus aberti*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/abertsquirrel.pdf

Kelly-Quinn, M. and J.J. Bracken. 1990. A seasonal analysis of the diet and feeding dynamics of brown trout, *Salmo trutta* L., in a small nursery stream. Aquaculture and Fisheries Management 21: 107-124.

Keppie, D.M. and C.E. Braun. 2000. Band-tailed pigeon (*Patagioenas fasciata*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/batpig1. Accessed 11 April 2017.

Korb, J.E. and J.D. Springer. 2003. Chapter 14 – understory vegetation from ecological restoration of southwestern ponderosa pine forests. Ecological Restoration Institute. p. 235.

Lemley, A.D. 1982. Modification of benthic insect communities in polluted streams: combined effects of sedimentation and nutrient enrichment. Hydrobiologia 87: 229-245.

Lenat, D.R. and M.T. Barbour. 1994. Using benthic macroinvertebrate community structure for rapid, cost-effective, water quality monitoring: rapid bioassessment. In S.L. Loeb and A. Spacie, editors. Biological monitoring of aquatic ecosystems. CRC Press. Boca Raton, FL. pp. 187-216.

Linkhart, B.D. and D.A. McCallum. 2013. Flammulated owl (*Psiloscops flammeolus*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/flaowl. Accessed 11 April 2017.

Lomolino, M.V., J.H. Brown, and R. Davis. 1989. Island biogeography of montane forest mammals in the American southwest. Ecology 70: 180-194.

Lowther, P.E., P. Pyle, and M.A. Patten. 2016. Cordilleran flycatcher (*Empidonax occidentalis*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/corfly. Accessed 11 April 2017.

Luce, R.J. and D. Keinath. 2007. Spotted bat (*Euderma maculatum*): a technical conservation assessment. [Online] USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/spottedbat.pdf. Accessed 29 March 2017.

Lyon, L.J. and A.G. Christensen. 2002. Elk and land management. In: D.E. Toweill and J.W. Thomas, editors. Elk of North America: ecology and management. Harrisburg, PA: Stackpole Books. Pp 557-581.

McCorquodale, S.M. 2013. A brief review of the scientific literature on elk, roads, and traffic. Washington Department of Fish and Wildlife: 26 pp.

McRoberts, J.T., M.C. Wallace, and S.W. Eaton. 2014. Wild turkey (*Meleagris gallopavo*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: https://birdsna.org/Species-Account/bna/species/wiltur. Accessed 6 April 2017.

Merrell, D.J. 1970. Migration and gene dispersal in *Rana pipiens*. American Zoologist 10:47-52.

Merrell, D.J. and C.F. Rodell. 1968. Seasonal selection in the leopard frog, *Rana pipiens*. Evolution 22: 284-288.

[NatureServe] NatureServe. 2015a. NatureServe Explorer: An online encyclopedia of life [*Lithobathes pipiens* – northern leopard frog]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 27 March 2017.

[NatureServe] NatureServe. 2015b. NatureServe Explorer: An online encyclopedia of life [*Accipter gentilis* – northern goshawk]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 28 March 2017.

[NatureServe] NatureServe. 2015c. NatureServe Explorer: An online encyclopedia of life [*Falco peregrinus anatum* – American peregrine falcon]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 28 March 2017.

[NatureServe] NatureServe. 2015d. NatureServe Explorer: An online encyclopedia of life [*Sorex cinereus* – cinereus shrew]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 29 March 2017.

[NatureServe] NatureServe. 2015e. NatureServe Explorer: An online encyclopedia of life [*Sorex palustris*– American water shrew]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 29 March 2017.

[NatureServe] NatureServe. 2015f. NatureServe Explorer: An online encyclopedia of life [*Euderma maculatum*– spotted bat]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 29 March 2017.

[NatureServe] NatureServe. 2015g. NatureServe Explorer: An online encyclopedia of life [*Speyeria nokomis nokomis*– nokomis fritillary]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 30 March 2017.

[NatureServe] NatureServe. 2015h. NatureServe Explorer: An online encyclopedia of life [*Cypripedium parviflorum* var. *pubescens*– large yellow lady's-slipper]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 3 April 2017.

[NatureServe] NatureServe. 2015i. NatureServe Explorer: An online encyclopedia of life [*Erigeron subglaber*– hairless fleabane]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 3 April 2017.

[NatureServe] NatureServe. 2015j. NatureServe Explorer: An online encyclopedia of life [*Baeolophus ridgwai*– juniper titmouse]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 4 April 2017.

[NatureServe] NatureServe. 2015k. NatureServe Explorer: An online encyclopedia of life [*Picoides villosus*– hairy woodpecker]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 5 April 2017.

[NatureServe] NatureServe. 2015l. NatureServe Explorer: An online encyclopedia of life [*Meleagris gallopavo*– wild turkey]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 6 April 2017.

[NatureServe] NatureServe. 2015m. NatureServe Explorer: An online encyclopedia of life [*Sciurus aberti*– Abert's squirrel]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 6 April 2017.

[NatureServe] NatureServe. 2015n. NatureServe Explorer: An online encyclopedia of life [*Tamiasciurus hudsonicus*– red squirrel]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 6 April 2017.

[NatureServe] NatureServe. 2015o. NatureServe Explorer: An online encyclopedia of life [*Cervus elaphus*– elk]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed: 7 April 2017.

Naylor, L.M., M.J. Wisdom, and R.G. Anthony. 2009. Behavioral responses of North American elk to recreational activity. The Journal of Wildlife Management 73: 328-338.

New Mexico Department of Game and Fish (NMDGF). 2013b. New Mexico wild turkey management plan 2013-2018. Santa Fe, New Mexico. Available at: http://www.wildlife.state.nm.us/download/conservation/species/birds/management-recovery-plans/Turkey-Management-Plan.pdf. Accessed 12 April 2016.

New Mexico Rare Plant Technical Council (NMRPTC). 1999. New Mexico rare plants. Albuquerque, New Mexico: http://nmrareplants.unm.edu/. Accessed 3 April 2017.

Olson, C.R. and T.E. Martin. 1999. Virginia's warbler (*Oreothlypis virginiae*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/virwar. Accessed 11 April 2017.

Patterson, B. 1980. Montane mammalian biogeography in New Mexico. The Southwestern Naturalist 25: 33-40.

Patton, D.R. and J.R. Vahle. 1986. Cache and nest characteristics of the red squirrel in an Arizona mixed-conifer forest. Western Journal of Applied Forestry 1: 48-51.

[PIF] New Mexico Partners in Flight. 2007. New Mexico bird conservation plan version 2.1. C. Rustay and S. Norris, compilers. Albuquerque, New Mexico. Available at: http://avianconservationpartners-nm.org/bird-conservation-plan-2/chapter-4-species-accounts/. Accessed 10 April 2017.

Pope, T.L., W.M. Block, and P. Beier. 2009. Prescribed fire effects on wintering, bark-foraging birds in Northern Arizona. The Journal of Wildlife Management 73: 695-700.

Pritchard, V.L. and D.E. Cowley. 2006. Rio Grande cutthroat trout (*Oncorhynchus clarkia virginalis*): a technical conservation assessment. U.S.D.A. Forest Service Rocky Mountain Region. 75 pp.

Raedeke, K.J., J.J. Millspaugh, and P.E. Clark. 2002. Population characteristics. In D.E. Toweill and J.W. Thomas, editors. Elk of North America: ecology and management. Harrisburg, PA: Stackpole Books; pp 449-491.

Reynolds, R.T., R.T. Graham, and M.H. Reiser. 1992. Management recommendations for the northern goshawk in the southwestern United States. GTR-RM-217. USDA Forest Service. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, CO.

Reynolds, R.T., A.J. Sanchez Meador, J.A. Youtz, T. Nicolet, and M.S. Matonis. 2013. Restoring composition and structure in southwestern frequent-fire forests. RMRS-GTR-310, USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Reynolds, R.T., D. Wiens, and S.R. Salafsky. 2006. A review and evaluation of factors limiting northern goshawk populations. Studies in Avian Biology 31: 260-273.

Reynoldson, T.B., R.H. Norris, V.H. Resh, K.E. Day, and D.M. Rosenberg. 1997. The reference condition: a comparison of multimetric and multivariate approaches to assess water quality impairment using benthic macroinvertebrates. Journal of the North American Benthological Society 16: 833-852.

Rees, D.E., R.J. Carr, and W.J. Miller. 2005. Rio Grande chub (*Gila pandora*): a technical conservation assessment. U.S.D.A. Forest Service, Rocky Mountain Region. 23 pp.

Rinne, J.N. 1995a. Reproductive biology of the Rio Grande sucker, *Catostomus plebeius* (Cypriniformes), in a montane stream, New Mexico. The Southwestern Naturalist 40: 237-241.

Rinne, J.N. 1995b. Reproductive biology of the Rio Grande chub, *Gila pandora* (Teleostomi: Cypriniformes), in a montane stream, New Mexico. The Southwestern Naturalist 40: 107-110.

Rinne, J.N. 1995c. Rio Grande cutthroat trout. In M.K. Young, editor. Conservation assessment for inland cutthroat trout, USDA Forest Service, General Technical Report RMGTR-256, Fort Collins, Colorado. pp 24–27.

Romero, G. 2017a. Pueblo Ridge Project silviculture report. Camino Real Ranger District, Carson National Forest. 23 March 2017. 55 pages.

Romero, G. 2017b. Personal communication. 23 March 2017.

Sauer, J.R., D.K. Niven, J.E. Hines, D.J. Ziolkowski Jr., K.L. Pardieck, J.E. Fallon, and W.A. Link. 2017. The North American breeding bird survey, results, and analysis 1966 - 2015. Version 2.07.2017. USGS Patuxent Wildlife Research Center, Laurel, MD. Available at: http://www.mbr-pwrc.usgs.gov/bbs/. Accessed 4 April 2017.

Schlossberg, S. and J.C. Sterling. 2013. Gray flycatcher (*Empidonax wrightii*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/gryfly. Accessed 10 April 2017.

Scott, J.A. and S.O. Mattoon. 1981(82). Early stages of *Speyeria nokomis* (Nymphalidae). Journal of Research on the Lepidoptera 20: 12-15.

[SEINet] Southwest Environmental Information Network. 2017. Available at: http://swbiodiversity.org/seinet/index.php. Accessed 3 April 2017.

Selby, G. 2007. Great Basin silverspot butterfly (*Speyeria nokomis nokimis* [W.H. Edwards]): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/greatbasinsilverspotbutterfly.pdf. Accessed 30 March 2017.

Smith, B.E. and D.A. Keinath. 2007. Northern leopard frog (*Rana pipiens*): a technical conservation assessment. U.S.D.A. Forest Service, Rocky Mountain Region. 67 pp.

Sogge, M., D. Ahlers, and S. Sferra. 2010. A natural history summary and survey protocol for the southwestern willow flycatcher. U.S. Geological Survey Techniques and Methods 2A-10, 38 pp.

Spencer, A.W. and D. Pettus. 1966. Habitat preferences of five sympatric species of long-tailed shrews. Ecology 47: 677-683.

Squires, J.R. and R.T. Reynolds. 1997. Northern goshawk (*Accipiter gentilis*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/norgos. Accessed 28 March 2017.

Stacier, CA. and M.J. Guzy. 2002. Grace's warbler (*Setophaga graciae*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/grawar. Accessed 11 April 2017.

Stahlecker, D.W., P.L. Kennedy, A.C. Cully, and C.B. Kuykendall. 1989. Breeding bird assemblages in the Rio Grande Wild and Scenic Recreation Area, New Mexico. The Southwestern Naturalist 34: 487-489.

Storz, J.F. 1995. Local distribution and foraging behavior of the spotted bat, *Euderma maculatum*, in northwestern Colorado and adjacent Utah. Great Basin Naturalist 55: 78-83.

Sublette, J., M.D. Hatch, and M. Sublette. 1990. Fishes of New Mexico. University of New Mexico Press, Albuquerque, NM. pp. 51-56.

USDA Forest Service. 1986. Carson National Forest land and resource management plan. Southwestern Region. Albuquerque, NM.

USDA Forest Service. 2011a. Biological assessment for re-initiation of consultation on the continued implementation of the land and resource management plans for the eleven national forests and national grasslands of the Southwestern Region. 614 pp.

USDA Forest Service. 2011b. Carson National Forest management indicator species. Available at: https://www.fs.usda.gov/detail/carson/landmanagement/planning/?cid=STELPRDB5212397. Accessed 21 March 2017.

USDA Forest Service. 2013. USFS R3 regional forester's sensitive species: animals – 2013. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_021328.pdf Accessed 24 March 2017.

U.S. Fish and Wildlife Service. 1995. Recovery plan for the Mexican spotted owl: Vol. I. Albuquerque, New Mexico. 347 pp.

U.S. Fish and Wildlife Service. 2008. Birds of conservation concern 2008. USDOI, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 58 pp.

U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; 12-month finding on a petition to change the final listing of the distinct population segment of the Canada lynx to include New Mexico. Federal Register 74(241): 66937-66950.

U.S. Fish and Wildlife Service. 2011. Endangered and threatened wildlife and plants; 12-month finding on a petition to list the northern leopard frog in the western United States as threatened; final rule. Federal Register 76(193): 61896-61931.

U.S. Fish and Wildlife Service. 2012. Final recovery plan for the Mexican spotted owl (*Strix occidentalis lucida*), First Revision. U.S. Fish and Wildlife Service. Albuquerque, New Mexico, USA. 413 pp.

U.S. Fish and Wildlife Service. 2014. Endangered and threatened wildlife and plants; revised designation of critical habitat for the contiguous United States distinct population segment of the Canada lynx and revised distinct population segment boundary; final rule. Federal Register 99(177): 54782–54846.

U.S. Fish and Wildlife Service. 2020. IPaC – Information, Planning, and Conservation System; Pueblo Ridge Restoration Project, Updated list of threatened and endangered species that may occur in proposed project location, and/or may be affected by proposed project. Consultation Code: 02ENNM00-2020-SLI-0085. 6 pp.

Vahle, J.R. and D.R. Patton. 1983. Red squirrel cover requirements in Arizona mixed-conifer forests. Journal of Forestry 81: 14-22.

Vierling, K.T., V.A. Saab, and B.W. Tobalske. 2013. Lewis's woodpecker (*Melanerpes lewis*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/lewwoo. Accessed 11 April 2017.

Wakeling, B.F., S.S. Rosenstock, and H.G. Shaw. 1998. Forest stand characteristics of successful and unsuccessful Merriam's turkey nest sites in north-central Arizona. The Southwestern Naturalist 43: 42-248.

Walters, E.L., E.H. Miller, and P.E. Lowther. 2014. Red-naped sapsucker (*Sphyrapicus nuchalis*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/rensap. Accessed 11 April 2017.

Whitacker, J.O. 1996. Abert's squirrel (*Sciurus aberti*). In: The Audubon Society Field Guide to North American Mammals. pp. 416-417.

White, C.M., N.J. Clum, T.J. Cade, and W. Grainger Hunt. 2002. Peregrine falcon (*Falco peregrinus*). In P.G. Rodewald, editor. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: https://birdsna.org/Species-Account/bna/species/perfal. Accessed 28 March 2017.

Woodbridge, B. and C.D. Hargis. 2006. Northern goshawk inventory and monitoring technical guide. Gen. Tech. Rep. WO-71. Washington, DC: U.S. Department of Agriculture, Forest Service. 80 pp.

## 5.4 Watershed

Elliot, W.J. 2005. Watershed analysis for fuel management operations. Draft chapter for a general technical report on the environmental consequences toolkit for applied wildland fire research in support of project level hazardous fuels planning. U.SDA Forest Service, Rocky Mountain Research Station, Moscow, ID. February 2005.

Gary, H.L. 1968. Soil temperatures under forest and grassland cover types in northern New Mexico. USDA Forest Service. Rocky Mountain Forest and Range Experiment Station. Research Note RM-118. 11 pp.

Harvey, A.E., M.J. Larsen, and M.F. Jurgensen. 1981. Rate of woody residue incorporation into northern Rocky Mountain forest soils. Research Paper INT-282. USDA Forest Service. Intermountain Forest and Range Experiment Station. 5 pp.

Hibbert, A.R. 1979. Vegetation management for water yield improvement in the Colorado River Basin. USDA Forest Service. Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 58 pp.

Johnson, R.S. 1984. Effect of small aspen clearcuts on water yield and water quality. USDA Forest Service, Intermountain Forest and Range Experiment Station. Research Paper INT- 333. 9 pp.

Klock, G.O. and W. Lopushinsky. 1980. Soil water trends after clearcutting in the Blue Mountains of Oregon. USDA Forest Service. Pacific Northwest Forest and Range Experiment Station. Research Note PNW-361. May 1980. 8 pp.

MacDonald, L.H. and J.D. Stednick. 2003. Forests and water: a state-of-the-art review for Colorado. Colorado Water Resources Research Institute Completion Report [CO Water Resour. Res. Inst. Complet. Rep.]. no. 196, pp. i-vi. 2003.

National Drought Mitigation Center (NDMC). Archived standardized precipitation index maps. https://drought.unl.edu

New Mexico Administrative Code (NMAC) 19.20.4. Natural Resources and wildlife, chapter 20 forest management, part 4 commercial timber harvesting requirements. http://www.srca.nm.gov

New Mexico Environment Department (NMED). 2009. Procedures for assessing use attainment for the state of New Mexico integrated Clean Water Act section 303(d)/305(b) water quality monitoring and assessment report: assessment protocol. New Mexico Environment Department. Surface Water Quality Bureau. June 19, 2009.

New Mexico Environment Department (NMED). 2010a. Standards for interstate and intrastate surface waters. http://www.srca.nm.gov

New Mexico Environment Department (NMED). 2010b. Record of decision for the 2010-2012 State of New Mexico section 303(d)/305(b) integrated list for assessed surface waters. New Mexico Environment Department. Surface Water Quality Bureau. July 29, 2010.

Powers, R.F., D.A. Scott, F.G. Sanchez, R.A. Voldseth, D. Page-Dumroese, J.D. Elioff, and D.M. Stone. 2005. The North American long-term soil productivity experiment: Findings from the first decade of research. Forest Ecology and Management. 220:31–50.

Reid, L.M. 2010. Cumulative effects of fuel treatments on channel erosion and mass wasting. Chapter 6 In: Cumulative effects of fuel management in the western United States. USDA Forest Service Rocky Mountain Research Station. General Technical Report RMRS-GTR-231. pp 101-125.

Robichaud, P.R., L.H. MacDonald, and R.B. Foltz. 2010. Fuel management and erosion. Chapter 5 In Cumulative effects of fuel management in the western United States. USDA Forest Service Rocky Mountain Research Station. General Technical Report RMRS- GTR-231. pp 79-100.

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology Press. Pagosa Springs, CO.

Troendle, C.A. 1983. The Deadhorse experiment: A field verification of the subalpine water balance model. Research Note RM-425. Rocky Mountain Forest and Range Experiment Station. Fort Collings, CO. 7 pp.

Troendle, C.A. 1988. Effect of partial cutting and thinning on water balance of the subalpine forest. Proceedings – Future forests of the mountain West: a stand culture symposium. September 29-Ocotber 3, 1986. Missoula, MT. USDA Forest Service. Intermountain Research Station. pp 108-116.

USDA Forest Service. 1986. Record of decision. Carson National Forest land and resource management plan environmental impact statement, as amended. Carson National Forest. Supervisor's Office. 208 Cruz Alta Road. Taos, NM 87571.

USDA Forest Service. 1987. Terrestrial ecosystems survey of the Carson National Forest. Southwestern Region.

USDA Forest Service. 1989a. Riparian area survey and evaluation system (RASES). USDA Forest Service Southwestern Region. Region 3. July 1989. 64 pp.

USDA Forest Service. 1990. Soil and water conservation practices handbook. Region 3 Transmittal. FSH 2509.22

USDA Forest Service. 1999. Forest Service Handbook. FSH 2509.18 Soil Management Handbook. R3 Supplement No. 2509.18-99-1 and 2509.18.2 Soil condition rating guide.

USDA Forest Service. 2011. National best management practices program. Nonpoint source pollution control for water quality management on National Forest System lands. Technical Guide Volume 1. The National Core BMPs Draft. March 18, 2011.

USDI Bureau of Land Management. 1998. Riparian area management. TR1737-15. A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas. 126 pp.

USDI Bureau of Land Management. 1999. Aquatic macroinvertebrate monitoring report. Prepared by Mark Vinson, National Aquatic Monitoring Center, Department of Fisheries and Wildlife, Utah State University, Logan, Utah. 25 January 1999.

USDI Bureau of Land Management. 2010. Aquatic invertebrate report for samples collected by USFS Carson National Forest. Prepared by Scott Miller, National Aquatic Monitoring Center, Department of Watershed Sciences, Utah State University. Logan, Utah. 20 April 2010.

U.S. Geological Survey. 2006. Questa baseline and pre-mining ground water quality investigation. 21. Hydrology and Water Balance of the Red River Basin, New Mexico 1930- 2004. Scientific Investigations Report 2006-5040.

## 5.5 Recreation

Taos Pueblo. 2018. Department of Natural Resources. Information about Public Law 91-550, the Taos Pueblo Wilderness Act. Available at: http://www.taospueblo.org/cms/natural-resources, accessed 9/12/18

USDA Forest Service. 2008 Recreation facility analysis. Carson National Forest proposed 5-year program of work. Southwest Region. Carson National Forest. 9p.

USDA Forest Service. 2015. Assessment report of ecological, social, and economic conditions, trends, and sustainability. Carson National Forest. New Mexico. September 2015. Accessed online 9/12/18: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd475212.pdf

USDA Forest Service. 2018. Carson National Forest recreation website. Campground descriptions and overview of recreation on the Carson National Forest. Available at: https://www.fs.usda.gov/recmain/carson/recreation, accessed 9/12/18

Vaux, H.J., Jr., P.D. Gardner, and T.J. Mills. 1984. Methods for assessing the impact of fire on forest recreation. Gen. Tech. Rep. PSW-79. USDA Forest Service. Pacific Southwest Forest and Range Experiment Station. Berkeley, CA. 19 p.

## 5.6 Heritage

Deats, S. 2016. Pueblo Ridge and Valle Escondido archaeological survey of 4,975 acres on the Camino Real Ranger District, Carson National Forest, Taos County, New Mexico. Ms. On file, Carson National Forest Supervisors Office, Taos, NM. (CNF Report No #2016-03-02-031)

USDA Forest Service. 2009. First amended programmatic agreement regarding historic property protection and responsibilities among New Mexico historic preservation officer and Arizona State historic preservation officer and Texas State historic preservation officer and Oklahoma State historic preservation officer and the Advisory Council on Historic Preservation and United States Department of Agriculture, Forest Service, Region 3. On file, Carson National Forest supervisor's office. Taos, NM.

## 5.7 Range

USDA Forest Service. 1986. Carson National Forest land and resource management plan. Southwestern Region. Albuquerque, NM.

USDA Forest Service. 1996. Environmental assessment for Capulin allotment. USDA Forest Service, Southwestern Region, Carson National Forest, Camino Real Ranger District; Peñasco, NM.

USDA Forest Service. 2012. National best management practices for water quality management on National Forest Systems lands, volume 1: national core BMP technical guide. USDA Forest Service, FS-990a.